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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Honours Hygiene.

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SEWERS.

In order to prevent deposit of solid matter, sewers should be constructed with a sufficient gradient, and of a shape which presents the least surface for friction in proportion to the amount of liquid to be conveyed. Where the gradient is not good, the sewer must be regularly flushed by locks or flushing gates which retain the sewage for a time, and when set free suddenly flush the next section of sewer; or by filling the manhole at the head of a section of sewer with water, and then suddenly releasing the water.

All brick sewers should be egg shaped, with the narrow end downwards. The egg is formed by two circles touching one another, the diameter of the upper circle being twice that of the lower.

This shape possesses the great advantage that when the depth of the stream is diminished the amount of wetted surface of sewer (*wetted perimeter*) is diminished in equal proportion, whereas in every other form of sewer it is relatively increased. Thus the friction, which depends on the extent of the wetted perimeter, is kept down to a minimum. Where, as in outfall sewers, the volume of sewage is large, and does not vary greatly in amount, the circular form may be preferable, as it is cheaper and stronger than the egg-shaped sewer. Below 18 inches internal diameter, sewers should be circular in section, and made of stoneware, not brick.

The *velocity of flow* depends upon (1) the hydraulic mean depth of the stream, and (2) its inclination or fall.

The *hydraulic mean depth* means the depth of a rectangular channel whose sectional area (and therefore the volume of whose current) equals that of the curved sewer or pipe, concerning which the calculation is made, and whose width equals the entire wetted perimeter of the sewer or pipe. It is thus equal to $\frac{\text{sectional area}}{\text{wetted perimeter}}$.

In the case of circular pipes, if we take the diameter to be 1, and assume the pipe to be running full, the sectional area $= \pi r^2$, where $\pi = 3{\cdot}1416$ and $r =$ half diameter.

The wetted perimeter $= 2\pi r$, that is, the circumference of the circle formed by the pipe.

Therefore hydraulic mean depth $= h = \frac{\pi r^2}{2\pi r} = \frac{1}{4}$

Similarly when the pipe runs half full

$$h = \frac{\frac{\pi r^2}{2}}{\frac{2\pi r}{2}} = \frac{1}{4}$$

The solution of problems where a smaller arc of a circle is occupied by fluid requires trigonometrical methods, and is not usually required in practice.

The *quantity of fluid discharged* in a given time is represented by the product of the sectional area of the stream into its velocity. The greater the hydraulic mean depth the greater is the velocity, if the inclination remains the same.

The *velocity of flow* is determined by Eytelwein's formula, which states that the mean velocity per second of a stream of water similar in form to those now under consideration is ten-elevenths of a mean proportional between the hydraulic mean depth and the fall in two English miles, if the channel were prolonged so far.

Thus if $f =$ the fall (in feet) in two miles,
$h =$ hydraulic mean depth in feet,
V = mean velocity per second.
Then $V = .9\sqrt{h \cdot f}$.
or if $v =$ velocity per minute, then
$v = 55\sqrt{h \cdot f}$.

It is more convenient to let $f =$ fall in one mile.

Then the formula becomes

$$v = 55\sqrt{h \times 2f}.$$

Example 34.—What is the velocity of flow of sewage in a 6-in. pipe running half full, and having a fall of 1 in 60; and what would be the discharge per minute in cubic feet and in gallons?

6 inches = $\frac{1}{2}$ foot.
r = radius = $\frac{1}{4}$ foot.

$$h = \frac{\frac{\pi r^2}{2}}{\frac{2\pi r}{2}} = \frac{\pi r^2}{2\pi r} = \frac{r^2}{2r} = \frac{1}{8}$$

1 in 60 = x in one mile
= x in 5,280 feet.
Therefore 1 in 60 = 88 in one mile.

$$v = 55\sqrt{h \times 2f} = 55\sqrt{\frac{176}{8}}$$
$$= 253 \text{ feet per minute.}$$

The amount of fluid discharged per minute = sectional area × velocity

$$= \frac{\pi r^2}{2} \times 253$$

$$= \frac{3{\cdot}1416}{32} \times \frac{253}{1} = 24{\cdot}83 \text{ cubic feet.}$$

But one cubic foot of water = 6·24 gallons (one gallon = ·16 cubic foot)
Therefore amount of fluid discharged per minute = 154·97 gallons.

Example 35.—What will be the flow of water through a 3-in. pipe 1,000 feet long running full, with a loss of head between the two ends equal to 5 feet?
(Edin. Univ. B.Sc. in Pub. Health, 1883.)

Here $h = \frac{\pi r^2}{2\pi r} = \frac{r}{2}$, in a pipe running full.

$$r = 3'' = \tfrac{3}{12} = \tfrac{1}{4}'$$
$$h = \frac{r}{2} = \frac{1}{8 \times 2} = \tfrac{1}{16}$$

Fall of 5 feet in 1,000 = x feet in 5,280 (one mile)
= 26 feet in mile

$$v = 55\sqrt{h \times 2f}$$
$$= 55\sqrt{\tfrac{52}{16}}$$
$$= 99 \text{ feet per minute.}$$

But if a = sectional area of stream
$v \times a$ = cubic feet of water discharged per minute.

$$a = \pi r^2$$
$$= \frac{3{\cdot}1416}{16}$$

$$v \times a = \frac{99 \times 3{\cdot}1416}{16} = 19{\cdot}44 \text{ cubic feet.}$$

Example 36.—How much sewage will a circular drain 3 feet in diameter running half full convey, the fall being 1 in 400? (Edin. Univ. B.Sc., 1875.)

Here $h = \frac{\frac{\pi r^2}{2}}{\frac{2\pi r}{2}} = \frac{r}{2} = \frac{3}{4}$

1 in 400 = x in 5,280 feet (*i.e.*, a mile)
f = 13·2 in a mile.

$$v = 55\sqrt{h \times 2f}$$
$$= 55 \times 4{\cdot}4 = 242 \text{ feet per minute}$$

$$a = \pi r^2 = \frac{3{\cdot}1416 \times 9}{4} = 1{\cdot}767$$

$$v \times a = 242 \times 1{\cdot}767 = 427{\cdot}9 \text{ cubic feet.}$$

Example 37.—In what way does the size and shape of a sewer affect the velocity of the sewage flowing through it? If a 12-inch pipe sewer, laid at a gradient of 1 in 175, gives a velocity of 3½ feet per second, what would be the velocity if the sewer had a gradient of 1 in 700 (the pipe running half full in each case); and would this latter velocity suffice to keep the sewer clear of deposit?
(Exam. Sanitary Institute for Surveyors, 1887.)

An elliptical sewer gives greater velocity of flow to small quantities of sewage than a circular one because it exposes a smaller surface for friction,

By formula = $v = 55\sqrt{h \times 2f}$

$h = \frac{1}{4} \therefore \sqrt{h} = \frac{1}{2}$
f = 1 in 175 = 30 feet in one mile.
$v = \frac{55}{2}\sqrt{60} = 212{\cdot}85$ feet per minute.

In the second case f = 1 in 700 = 7·56 feet in one mile.

$$v = \tfrac{55}{2}\sqrt{15{\cdot}12} = 106{\cdot}97 \text{ feet per minute.}$$

Thus in the first case there is a velocity 3·55 feet per sec., and in the second case of 1·78 feet per sec. The latter velocity is quite insufficient to keep the sewer free from deposit, 3 ft. per sec. being the minimum velocity required for that purpose.

Example 38.—Given a sewer 3 feet in diameter, with a fall of 1 in 1,760, what would be the relative discharge if the fall were 1 in 5,280?

In first case 1 in 1,760 = 3 in mile
1 in 5,280 = 1 in mile

$$h = \frac{r}{2} = \frac{3}{4}$$

$$v = 55\sqrt{h \times 2f}$$
$$= 55\sqrt{\tfrac{3}{4} \times 6} = \frac{165}{\sqrt{2}} = 118$$

In second case $v' = 55\sqrt{\frac{3}{4} \times 2} = 55\sqrt{\frac{3}{2}} = 67{\cdot}9$.
Thus the velocity of the two streams would be as 118 : 67·9.

Example 39.—Supposing a sewer to have a gradient of 1 in 300, how much would the velocity and discharge be increased by altering the gradient to 1 in 100? (Sanitary Institute Exam. for Surveyors, 1886.)

1 in 300 = 17·6 in mile.
1 in 100 = 52·8 in mile.

As h is not given, we must assume it = ¼, as it does in circular sewers running full or half full.

$$v = 55\sqrt{h \times 2f}$$
$$= 55\sqrt{\tfrac{34}{4}} = 160.28 \text{ per minute.}$$
$$v' = 55\sqrt{\tfrac{106}{4}} = 282.15 \quad \text{,,}$$

If reckoned per second, there is an increase of 1·99 feet per second in velocity.

Example 40.—Describe the relation existing in a sewer between gradient, volume, velocity and size.
(Exam. Sanitary Institute for Local Surveyors, 1889.)

By the formula $v = 55\sqrt{h \cdot f}$.
Where v = velocity in feet per minute
h = hydraulic mean depth = $\frac{\text{area of cross section of stream}}{\text{wetted perimeter}}$
f = fall in feet in two miles.

In circular sewers $h = \frac{\text{diameter}}{4}$

Thus the velocity varies as the square root of h or f.

The volume discharged varies with the value of the factor $v \times a$ where a = sectional area of stream.

If h remains constant, with a varying value of a, then the volume discharged may remain constant. Thus h and v in a circular sewer are the same, whether the sewer runs full or half full. In a V-shaped channel the velocity remains the same whatever the depth of the stream, as its bed and area preserve the same proportions. An egg-shaped sewer approximates the V shape in form.

Similar volumes of sewage have velocities which vary not only with the amount of fall, but the size of the sewer. The friction, as represented by the wetted perimeter, would be much less with sewage half filling a circular sewer, than with the same amount of sewage forming a broad shallow stream on the invert of a larger sewer.

(To be continued.)

How a Scotch School was Examined.

INFANTS.

Reading.—Chambers' Graduated Primers I. and II., also Collins' Infant Reader. There were three classes, and the Inspector took them out and heard each scholar read a few lines. Then hearing a few simple words spelt orally he proceeded to test the intelligence from the simple matter contained in the lessons.

Writing.—Spelling the words North, South, East, and West, the highest class wrote them on slates, while the younger ones wrote the small letters from a to m, and the capitals from W to Z.

Arithmetic.—Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, and the numbers 19, 18, 17 were made to dictation, then oral questions such as 7 and 2? 9 and 3? 12 and 4? 7 from 12? 8 from 13? the price of 6 twopenny oranges? 5 threepenny slates?

Object Lesson.—'Colour,' by a pupil teacher. 'The Pig,' by the infant mistress.

Music.—The modulator in easy steps, and an action song, 'The Tinker.'

STANDARD I.

Reading.—From Chambers' Graduated and Nelson's Royal Star. The 'Sea-shore' and 'The Five Senses' from the former, and 'The Little Gardener' from the latter. Easy questions for intelligence and grammar of nouns.

Writing.—*A.* 'It is very nice to take off one's shoes and stockings.'

B. 'We shall have a good crop this year.'

Arithmetic.—

(1) 218 + 90 + 300 + 45 + 69.

(2) 987 + 869 + 753 + 864 + 576.

(3) Take 319 from 501.

Object Lesson with infant classes.

Music.—Along with Standard II., which see.

Sewing.—Six girls taken to do the work as shown for this Standard on Schedule 3.

STANDARD II.

Reading.—Chambers' Graduated and Nelson's Royal Star. 'The Dog and the Wolf' from the former, and 'The King of Beasts' from the latter. The intelligence was more strictly tested here than in Standard I. and the grammar of adjectives and verbs was taken.

Writing.—The copy-books were put into the hands of the pupils, and the Inspector went round to examine them.

Dictation.—'As the two knights came up to the statue from opposite ways each saw but one side of the shield; one saw the iron side.'

Arithmetic.—

A. (1) 2,095 + 7,864 + 9,002 + 7,090 + 98 + 7,869 + 8,572.

(2) From 9,008 take 709.

(3) Multiply 9,876,534 by 6.

B. (1) 9,025 + 4,687 + 2,008 + 8,120 + 871 + 6,879 + 804.

(2) From 9,070 take 871.

(3) Multiply 869,437 by 5.

Music.—Modulator:—Key C:

d s n d r f l s f e s f n r l t d' s n r l r s r t s f t, d.

Song.—Perthshire Song Book: 'Twas in the month of March.'

STANDARD III.

Reading.—Royal Scottish Reader and Nelson's Royal Star. Lessons were read from each, and after strict testing of intelligence and the grammar of nouns, verbs, adjectives and pronouns, the

Repetition was heard.—'Lord Ullin's Daughter.' Each child repeated a verse, and then the Inspector asked the meaning of the words and phrases.

Writing.—Five lines were taken from the Lesson on 'Truthfulness,' paragraph 1.

Arithmetic.—

A. (1) Multiply 30,796 by 2,075 (words).

(2) Divide 186,072,480 by 495.

(3) Divide 40,827,108 by 84.

(4) Take £32 7s. 6¾d. from £4,030 0s. 4½d.

B. (1) Multiply 948,063 by 5,706 (words).

(2) Divide 558,049,700 by 745.

(3) Divide 3,006,661 by 79.

(4) From £10,750 take £942 5s. 3¼d.

C. (1) Multiply 397,485 by 6,805.

(2) Divide 283,896,772 by 379.

(3) Divide 3,726,128 by 68.

(4) Add together £84 5s. 8½d.; £496 0s. 0¾d.; £507 19s. 3½d.; £8,936 18s. 11½d.

History.—Questions on the Life and Wanderings of Bruce—Particulars of the Battle of Bannockburn—Life of Mary Queen of Scots.

Geography.—Definitions of cape—mull—ness—sea—lake—river, with illustrations of these from map of Scotland. Geography of capes—openings—lakes—rivers and chief towns.

Music taken with IV., V., VI. See under VI.

Sewing.—Eight girls taken.

STANDARD IV.

Reading.—All read from Nelson's Royal Star and Royal Scottish Readers. Lesson from the former was 'The Lady of the Woods,' and two or three paragraphs from the reign of Charles II. in the latter. The poetry for Repetition was the 'Wreck of the Hesperus.' After each had repeated four lines, the meaning of words and phrases was asked from the pupils at random. The Inspector next examined the grammar. He tested the class on their power to define 'Subject, Predicate and Object.' Giving a subject he would ask the pupils to supply a predicate; giving predicates, he asked them to supply subjects, and so on. He followed this up by choosing inverted sentences from the reading book, requiring the pupils first to arrange the words in the usual order and then to analyse them.

Writing.— Dictation.—'Let us see if we can explain it to you. The water in all these rivers, lakes and oceans, is constantly rising into the air in the form of moisture or vapour. We cannot see this moisture, neither can we see the air. If the air is cold moisture does not rise rapidly, but as the air becomes heated it takes up more moisture; so that the more heat there is in the air the more moisture arises.

Arithmetic.—

A. (1) Multiply £8 6s. 8d. by 316.

(2) Divide £18,344 os. 6d. by 189.

(3) How many minutes in September, October and November?

(4) Reduce £19 16s. 6d. to threepences.

B. (1) Multiply £65 4s. 6½d. by 395.

(2) Find the value of 60 half sovereigns, 82 half-crowns, 25 florins, 17 threepences and 290 pence.

(3) How many inches in 1½ miles (1,760 yds. = 1 mile)?

(4) Divide 680 ac. 1 ro. 24 pls. by 21.

C. (1) Divide £30,064 13s. 6d. by 82.

(2) Multiply £248 1s. 11d. by 365.

(3) Multiply 3 cwts. 2 qrs. 12 lbs. by 3, and subtract the result from 1 ton.

(4) Reduce 3,656 half-crowns to florins.

History.—Queen Anne's reign—Causes that led to the union of the Parliaments—War of the Spanish Succession—its causes—Marlborough's victories—His public character—How he lost his position—Anne's leaning towards the Tories—General questions on preceding reigns.

Geography.—The river system of England, with the reason for the relative length of the rivers on East and West mountains of Ireland—situation of, and notes on the following towns:—Belfast, Cork, Galway, Wexford, Dublin, Limerick, Enniskillen, London, Hull, Cambridge, Oxford. Great seaports on South and West.

STANDARD V.

Reading.—Taken from Royal Star, No. V., on 'Water,' page 103. Each one read, and the following meanings were asked of the whole class: 'To realize,' give other words in *-ize*, with meanings; 'traverse,' what does *tra* stand for? other words beginning with *trans*? what is a 'raft?' 'lumber?' a 'man' who cuts lumber? where employed? what is a rivulet? a freshet? other endings that signify small things.

Writing.—The following story was read: 'There was once a blacksmith who was a very good singer, but was fond of whiskey. He used to go to a friend's house to practise his singing. Returning home one night he visited an inn for refreshment, and left rather tipsy, and while rolling along the road he continued to sing in a loud voice. A bull which was sleeping close by was aroused, and, charging the man, tossed him over a hedge. Alighting on a heap of hay unhurt, he was heard to exclaim, "You may be a good singer, but you are no gentleman."'

Arithmetic.—

A. (1) Find by practice the price of 937½ yards at £3 17s. 8d. per yard.

(2) 46 articles at 2s. 5d. each.
52 „ at £2 2s. 6d. per doz
73 „ at 9¾d. each.
14 score at 2d. each.

(3) If 6 cwts. 3 qrs. cost £3 4s. 8d., what quantity can be got for £1 4s. 3d.?

(4) $(1\frac{1}{2} + 3\frac{1}{3} - 3\frac{3}{4}) \div (5\frac{1}{3} - 4\frac{1}{8})$.

B. (1) 708 articles at £3 14s. 11¼d. each (Practice).

(2) Multiply 25 tons 3 qrs. 16 lbs. by 73.

(3) If 17 lbs. cost 7s. 1d., what will 1 cwt. 2 qrs. 8 lbs. cost?

(4) $(3\frac{3}{4} \times \frac{2}{15}) \div (1\frac{1}{2} \times \frac{2}{25})$.

C. (1) Find by practice the cost of 379 articles at £4 17s. 5¾d.

(2) Bill: 1 cwt. 2 qrs. at 3½d. per lb.;
18 lbs. at 7½d. per lb.;
42 lbs. at 6½d. per lb.;
25 doz. at 1s. 11d. per doz.

(3) A cart load weighing 2 tons 7 cwts. 2 qrs. cost £1 11s. 8d. Another of the same kind cost £1 15s. 10d.; what was the weight of the latter?

(4) Multiply $2\frac{1}{4} \div 4\frac{1}{2}$ by $\frac{2}{3} + \frac{3}{4}$.

Repetition.—'The Saxon and the Gael.'

Grammar.—Definitions of extension—enlargement—noun sentence—adjective sentence—adverb sentence, with examples from Reader.

History.—The Wars under the three Georges, with battles, leaders and dates.

Geography.—Map drawing: (1) Iberian Peninsula—(2) Scandinavia—(3) British North America—Questions on Canada—Divisions—Mountains—Rivers—Towns—Industries, particularly timber and fish trade.

STANDARD VI.

Reading.—Taken with Standard V. Grammar and Repetition taken with the same Standard.

Writing.—Essay on the 'Seasons,' 'A Visit to a Farm,' or 'A Boating Expedition.'

Arithmetic.—

A. (1) 70 lbs. at 1s. 4½d. per cwt.;
4 qrs. at £2 8s. per qr.;
2 cwt. 1 qr. at 5s. 5½d. per stone;
1 qr. at 5¾d. per lb.

(2) Simplify—

$$\frac{\frac{3}{11} \text{ of } (2\frac{2}{5} - \cdot 75) - \frac{3}{15}}{\frac{1}{21} - 6\cdot 8}.$$

(3) A, B and C do a piece of work in 12 days, A and B do it in 24 days, A and C do it in 20 days; how many days will C take to do it?

(4) If 5 horses plough 37½ acres in 6 days, how many acres will 40 horses plough in 5 days?

B. (1) If 12 men do a piece of work in 90 days of 10 hrs. each, in what time will 23 men do the same at 9 hrs. a day?

(2) If $\frac{13}{30}$ cwt. cost £14 6s., what would $21\frac{9}{13}$ cwt. cost?

(3) Add together 2·095 hrs., ·07 days, ·05 weeks, and reduce the result to the decimal of 365 days.

(4) Find simple interest on £1230·4 for 2·75 years at 5·25 per cent.

C. (1) If 6 horses plough 15 ac. in 12 days, how many acres will 14 horses plough in 30 days?

(2) If $4\frac{9}{10}$ inches cost 3s. 4d., what will 6½ yds. cost?

(3) Divide 1574·88 by ·000772.

(4) Find the interest on £765 6s. 8d. for 4 years 73 days at 3 per cent.

History.—The wars of Victoria's reign, and the changes in the Constitution.

Geography.—Map-drawing: (1) Australia; (2) India; (3) New Zealand. Questions on ocean routes—trade between this country and the Colonies—the physical features, divisions, and towns of South America.

MUSIC FOR III., IV., V., VI.

Modulator.—Key C.

(1) s f m r d s ₑd t, d m r d ₑs f m s l t d¹.

(2) d¹ t l se l t d¹ l r¹ d¹ t l d¹ t l se l d¹ t l se l s fo s d¹ ta l t d¹.

Time Test.—

d :—	:	d :d	d :-.d	d :d.d	:

Ear Test.—m s r m || d m s f || r s f m || s l t d¹.

STANDARDS III AND IV.

On Blackboard.

Key G.

:s,	d :d	r :r	m :-.r	d :s,	f :f	m.r:m.f	r :—	:s,
f :f	r :r	s :-.s	l.s:f.m	r :r	t, :t,	d :—	:

Key F.

:d	d.m :s	:s	l :s	:f	m.r :d.m	:s.m	r :—	:.d
f .f :r	:r	d .m :s	:.d¹	s .f :m	:r	d :—	:

STANDARDS V. AND VI.

Key F.

m.m :m .m :r .m	s.,f : f	:	r.,m :f .s :l .s	m :—	:
d.,d :d .d :t,.d	s.,r : r	:	t,.,d :r .m :f .m	d :—	:
m.m :m .m :r .m	s.,f : f	:	r .,m :f .s :l .s	m :—	:s.,s
d.,d :d .d :t,.d	m.,r : r	:	t,.,d :r .m :f .m	d :—	:m.,m
t :-.t :l .s	d¹.,s : s	:s.,s	t :-.t :l .s	d¹.,s : s	:m .f
r :-.r :f .f	m :m	:m.,m	r :-.r :f .f	m :m	:d .r
s :-.d¹ :t .l	s :—	:l .l	s :-.m :r .m	d :—	:
m :-.l :s .f	m :—	:f .f	m :-.d :t,.s	d :—	:

Contracted Arithmetic.

BY J. L. RICHARDSON.

SECTION XXV.

Division by Digits followed by Cyphers.

Cut off from the right of the dividend as many digits for the remainder as there are cyphers in the divisor. Divide the rest of the number by the hundreds, or other significant digit, for the quotient. Any quantity remaining from this division must be prefixed to the figures first cut off for the true remainder.

Example:—64525 ÷ 700. As there are two cyphers in the divisor we cut off as many figures to the right of the dividend. We thus have 645, with remainder 25. Dividing 645 by 7 we have 92 and 1 over. The 1 we prefix to the 25 first cut off, and obtain the true answer—92 + 125.

EXERCISE XXVIII.

By 80. 1. 99. 2. 764. 3. 349. 4. 5,362. 5. 63,180.

By 90. 6. 94. 7. 926. 8. 438. 9. 2,721. 10. 27,368.

By 700. 11. 3,664. 12. 85,295. 13. 7,248. 14. 37,214. 15. 98,756.

By 600. 16. 2,843. 17. 45,362. 18. 65,429. 19. 3,716. 20. 48,245.

By 5,000. 21. 352,946. 22. 281,764. 23. 318,754. 24. 289,201. 25. 512,638.

By 4,000. 26. 263,841. 27. 928,014. 28. 326,854. 29. 284,076. 30. 709,823.

SECTION XXVI.

Division by 5, 15, 25, 75, &c.

In dividing by the above numbers we avail ourselves of the arithmetical principle that the divisor and dividend may be equally increased or diminished without affecting the quotient. Hence we have the following rules:—

1. *To divide by 5:* Double the dividend; cut off the last figure and halve it for the true remainder.

2. *To divide by 15:* Double the dividend; cut off the last figure for partial remainder; divide by 3, prefixing any number over to the figure cut off, which divide by 2 for the true remainder.

3. *To divide by 25:* Multiply by 4; cut off two figures for remainder, which divide by 4.

4. *To divide by 75:* Multiply by 4; cut off two figures; divide by 3, prefixing any remainder to the cut off figures, which divide by 4 for true remainder.

Examples:—

1. 5,326 ÷ 5. 5,326 × 2 = 1065(2. Ans. $1065\frac{1}{5}$.

2. 5,326 ÷ 15. 5,326 × 2 = 1065(2. 1,065 ÷ 3 = 355. Ans. $355\frac{1}{15}$.

3. 5,326 ÷ 25. 5,326 × 4 = 2130(4. Ans. $213\frac{1}{25}$.

4. 5,326 ÷ 75. 5,326 × 4 = 213(04. 213 ÷ 3 = 71. Ans. $71\frac{1}{75}$.

EXERCISE XXIX.

By 5 1. 384. 2. 5,962. 3. 3,856. 4. 2,940. 5. 3,682. 6. 58,123. 7. 479,621. 8. 784,627. 9. 582,145. 10. 678,902.

By 15. 11. 649. 12. 382. 13 578. 14. 642. 15. 9,801. 16. 3,548. 17. 7,890. 18. 1,325. 19. 62,901. 20. 41,830.

By 25. 21. 3,860. 22. 54,231. 23. 7,642. 24. 819. 25. 736. 26. 3,810. 27. 27,196. 28. 5,401. 29. 9,281. 30. 3,572.

By 75. 31. 9,506. 32. 7,653. 33. 8,402. 34. 35,678. 35. 4,560. 36. 56,025. 37. 38,235. 38. 78,645. 39. 97,820. 40. 456,830.

SECTION XXVII.

Division by 125, 250, 1,250.

A similar principle to that illustrated in Section 26 enables us to deal with these numbers. As they are respectively one-eighth of a thousand, one-fourth of a thousand, and one-eighth of ten thousand, we have the following rules:—

1. *To divide by 125:* Multiply by 8, and cut off three figures, which divide by 8 for remainder.

2. *To divide by 250:* Multiply by 4, and cut off three figures, which divide by 4 for remainder.

3. *To divide by 1,250:* Multiply by 8, and cut off four figures, which divide by 8 for remainder.

Examples:—

1. 38,463 ÷ 125; 38,463 × 8 = 307(704; $307 + \frac{704}{8} = 307\frac{88}{125}$. Ans.

2. 38,463 ÷ 250; 38,463 × 4 = 153(852; $153 + \frac{852}{4} = 153\frac{213}{250}$. Ans.

3. 38,463 ÷ 1,250; 38,463 × 8 = 30(7704; $30 + \frac{7704}{8} = 30\frac{963}{1250}$. Ans.

EXERCISE XXX.

By 125. 1. 71,234. 2. 89,625. 3. 43,876. 4. 54,820. 5. 35,160. 6. 88,245. 7. 678,090. 8. 105,026. 9. 789,129. 10. 3,454.

By 250. 11. 78,290. 12. 681,430. 13. 58,120. 14. 72,530. 15. 48,176. 16. 3,890. 17. 47,823. 18. 51,800. 19. 21,973. 20. 65,480.

By 1,250. 21. 326,904. 22. 582,963. 23. 412,803. 24. 618,290. 25. 3,825,876. 26. 2,041,589. 27. 7,890,123. 28. 4,567,890. 29. 6,827,934. 30. 4,125,892.

ANSWERS.

EXERCISE XXVIII.

1. 1 + 19.	2. 9 + 44.	3. 4 + 29.
4. 67 + 2.	5. 789 + 60.	6. 1 + 4.
7. 10 + 26.	8. 4 + 78.	9. 30 + 21.
10. 304 + 8.	11. 5 + 164.	12. 121 + 595.
13. 10 + 248.	14. 53 + 114.	15. 141 + 56.
16. 4 + 443.	17. 75 + 362.	18. 109 + 29.
19. 6 + 116.	20. 80 + 245.	21. 70 + 2,946.
22. 56 + 1,764.	23. 63 + 3,754.	24. 57 + 4,201.
25. 102 + 2,638.	26. 65 + 3,841.	27. 232 + 14.
28. 81 + 2,854.	29. 71 + 76.	30. 177 + 1,823.

EXERCISE XXIX.

1. 76 + 4.	2. 1,192 + 2.	3. 771 + 1.
4. 588.	5. 736 + 2.	6. 11,624 + 3.
7. 95,924 + 1.	8. 156,925 + 2.	9. 116,429.
10. 135,780 + 2.	11. 43 + 4.	12. 25 + 7.
13. 38 + 8.	14. 42 + 12.	15. 653 + 6.
16. 236 + 8.	17. 526.	18. 88 + 5.
19. 4,193 + 6.	20. 2,788 + 10.	21. 154 + 10.
22. 2,169 + 6.	23. 305 + 17.	24. 32 + 19.
25. 29 + 11.	26. 152 + 10.	27. 1,087 + 21.
28. 216 + 1.	29. 371 + 6.	30. 142 + 22.
31. 126 + 56.	32. 102 + 3.	33. 112 + 2.
34. 475 + 53.	35. 60 + 60.	36. 747.
37. 509 + 60.	38. 1,048 + 45.	39. 1,304 + 20.
	40. 6,091 + 5.	

EXERCISE XXX.

1. 569 + 109.	2. 717.	3. 351 + 1.
4. 438 + 70.	5. 281 + 35.	6. 705 + 120.
7. 5,424 + 90.	8. 840 + 26.	9. 6,313 + 4.
10. 27 + 79.	11. 313 + 40.	12. 2,725 + 180.
13. 232 + 120.	14. 290 + 30.	15. 192 + 176.
16. 15 + 140.	17. 191 + 73.	18. 207 + 50.
19. 87 + 223.	20. 261 + 230.	21. 261 + 654.
22. 466 + 463.	23. 330 + 303.	24. 494 + 790.
25. 3,060 + 876.	26. 1,633 + 339.	27. 6,312 + 123.
28. 3,654 + 390.	29. 5,462 + 434.	30. 3,300 + 892.

(To be continued.)

Practical Kindergarten Lessons for English Elementary Schools.

BY MRS. MORTIMER.

Lecturer at the Home and Colonial Training College.

XVIII.

GIFT XIX.

EXAMPLES OF LESSONS.—PEAWORK.

THE materials for this occupation consist of round thin sticks about 10 or 12 inches long, and peas previously soaked in cold water for about 12 hours. The sticks have to be cut the required lengths and sharpened at both ends. This should be done by the children, who will therefore require pocket knives. Edges are again represented by the sticks, and corners by the peas.

In stick-laying only the outlines of objects were produced; but in this occupation, owing to the peas which are used as a means of combination, skeletons of objects are produced; these are more instructive than the mere outlines, and their durability renders them more gratifying to the children.

Peawork is adapted to the more advanced pupils, as great care is needed in the use of the pocket knife in sharpening the sticks, and in cutting them the required length; and again it is not very easy to put the sticks exactly in the centre of the pea.

As with the previous occupations, when this is first introduced, the teacher and children talk about the material to be used. The teacher then shows the children the length they are to cut their sticks. It is a very good plan to give one of the required length to each child. The teacher then sharpens a stick to show them that the point should be like that of a nicely sharpened pencil, going off gradually to a point.

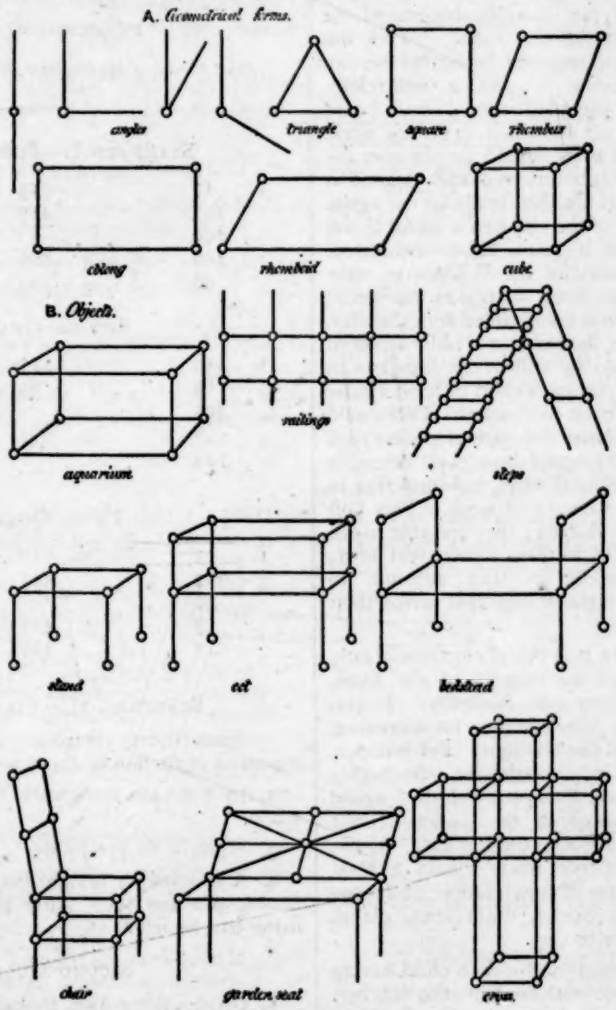

Plate XLIV.

One stick is held up and a pea put on one end, then another stick is joined to it to make a straight line, then acute, obtuse, and right angles should be made by combining two sticks with one pea.

Next three sticks are joined by means of two peas into a longer line, and into angles with one long and one short side. The children then proceed to make triangles, squares, oblongs, &c.

Many letters and numerals may be made with peas and sticks.

From the square a cube can easily be made, and from this may be produced many forms, for example, a chair, birdcage, &c.

With the peas and sticks the children can make many pretty objects, which they can take home and give as presents to their friends. Tables, sideboards, baskets, wheelbarrows, &c., may all be made; indeed almost any object may be constructed with this material.

It would be well for the teacher to work with the children; she should have a pattern in peawork for them to copy, especially when the object is rather difficult. The objects made by the children again form subjects for instructive conversations between the teacher and children, hence this gift materially helps the children to acquire much useful information.

GIFT XX.—MODELLING.

The material for this occupation is a plastic substance such as clay, wax, gutta percha, or even putty. Wooden knives are sometimes used; these are of various shapes.

As the clay soon becomes dry and then loses its plastic character, it will be necessary to keep it in a cool place and cover it with a wet cloth. A closely fitting tin or zinc-lined box is admirably suited for the purpose of keeping the clay moist. Work not finished in one lesson and required for further use can be preserved by covering it with a wet cloth. Each child should be provided with a small board and a piece of oiled paper on which to do his work, or covers made of oiled baize should be put over the desks. These can be easily removed and cleaned at the end of the lesson and are then ready for use again. If this be done by some of the children a useful lesson is given to them and a good habit inculcated. It would be advantageous for the children to wear pinafores or blouses with long sleeves, as this would prevent their clothes from being soiled with the clay. As the pupils advance in the work, or if older children are being taught, it would be well to use boards with cross lines on them and for each child to have a ruler divided into inches and even half inches. This would enable the teacher to have the various geometrical figures made to scale and would be a great incentive to the child in more advanced work, teaching him to place greater value on accuracy of work. This Gift is very popular with the childen; they are able to see the results of their work in, to them, a more real form; they have greater freedom as they advance in skill, and are able to make things that strike their fancy.

The teacher will notice that this occupation greatly strengthens and develops the muscles of the hand, producing greater dexterity and flexibility. It also gives the teacher many opportunities for increasing the general knowledge of the children. For instance, the substance used—clay—should be thoroughly described to the children; the word 'plastic' would introduce other substances to the notice of the children, and of course lessons would follow. Again, 'baked' clay and articles thus made should at least be mentioned in the course of conversation, and some of the things such as bricks, drain-pipes, plates, cups, etc., might be made in clay.

This occupation is carried out by each child having a piece of clay and at first working with the teacher. The teacher, taking a piece of clay, should roll it into a ball, the children doing the same. From this ball or sphere many objects may be made—an apple, pear, plum, cherries, potato, etc.

The cylinder should follow the sphere and should be made from it. Simple objects such as a roller, cigar, bottle, sack of flour, etc., are easily produced.

The other solid from Gift II.—the cube—should now be made and from it many objects such as a box, house, coffee mill, etc. Other simple solids should next be modelled, and afterwards a number of common objects, the children sometimes suggesting the object to be modelled, while the more advanced pupils should be allowed to work by themselves. To encourage the children to execute good work the best productions should be preserved in the School Museum.

(The end.)

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Quarterly Arithmetical Tests.

BY JOSEPH WOLLMAN,

Head Master of the Wellgate Board School, Rotherham.

STANDARD I.—FIRST QUARTER.

1. 17, 103, 240, 386, 98

2. 973 − 412

3. 806 − 503

4. A woman had 276 eggs left after selling 489. How many had she at first?

SECOND QUARTER.

1. 539, 83, 205, 6, 794

2. 573 − 65

3. 684 − 7

4. John's father is 53 years old, and John is 15. How much younger is John than his father?

THIRD QUARTER.

1. 5, 612, 78, 9, 843

2. 710 − 541

3. 427 − 329

4. Mary has 27 nuts, and her sister has 4 less. How many have they together?

STANDARD II.—FIRST QUARTER.

1. From thirty thousand and sixteen take one thousand eight hundred and seven.

2. 79 + 70,460 + 8,507 + 618 + 300 + 12,785 + 5,096.

3. Multiply 86,470 by 65.

4. A shopkeeper bought two boxes of oranges containing 980 and 870. After he had sold 1,536, how many had he left?

SECOND QUARTER.

1. Divide thirty-nine thousand five hundred and four by four, and write the answer in words.

2. 79,038 × 870.

3. What must be added to 19,518 to make 20,415?

4. A woman had two thousand eggs, and she sold 56 baskets, each containing two dozen. How many had she left?

THIRD QUARTER.

1. Find the difference between seventy thousand four hundred and six and eighty thousand and sixty-three.

2. Find the product of 6,957 and three thousand and nine.

3. How many dozen are contained in ninety-four thousand one hundred and eighty-eight?

4. The Severn is 220 miles long, the Thames 210 miles, the Trent 180 miles, and the Ouse 150 miles. How much longer are the Thames and the Trent than the Severn and the Ouse?

STANDARD III.—FIRST QUARTER.

1. How often is 59 contained in 4,016,425?

2. Divide the sum of 89,068 and 398,084 by 816?

3. Multiply 729 by 308, and divide the product by 297.

4. The quotient in a division sum is 6,954, the divisor is 546, and the remainder is half the divisor. What is the dividend?

SECOND QUARTER.

1. What is the difference between twenty thousand pounds and twenty pounds and three halfpence?

2. £68 14s. 10¼d. + £795 13s. 9½d. + £987 8s. 5¾d. + £859 6s. 11½d. + £304 17s. 8¾d. + £72 19s. 6½d.

3. How many wagonettes, each holding 28, will be required for 567 girls and 441 boys?

4. A boy had three florins. He spent 3s. 6d. for a bat, 1s. 3d. for a ball, and 9d. for a belt. How much had he left?

THIRD QUARTER.

1. Find the sum of £86 11s. 10¾d., £1,009 16s. 11¼d., 15s. 9¾d., £70,560 13s. 8¼d., £8 18s. 5½d., and £6,047 12s. 7¾d.

2. A man gave a sovereign to three of his sons. The eldest received 8s. 6d., and the second 10d. less. How much did the third get?

3. What must you add to seven thousand and ninety-eight pounds nineteen shillings and ninepence three farthings to make fifty thousand and seventeen pounds twelve shillings and fivepence halfpenny?

4. Two girls and a boy saved five pounds. Each girl saved £1 7s. 9d. How much did the boy save?

STANDARD IV.—FIRST QUARTER.

1. Multiply the difference between £387 15s. 9¾d. and £716 13s. 5½d. by 159.

2. Divide £61 2s. 7d. by 68.

3. A man earns £3 10s. a week, and spends £28 15s. a quarter. How much does he save yearly?

4. What amount must be multiplied by 459 to produce £168,813 10s. 1½d.?

SECOND QUARTER.

1. Reduce three-quarters of a million inches to miles, fur., chains, &c.

2. How many florins are equal to 3,796 half-crowns?

3. How many parcels of tea, each containing 7½ lbs., can be made from 1 ton 11 cwt. 1 qr. 10 lbs.?

4. A farmer bought 23 sheep for £69 10s. After spending 5 guineas on food, he sold them at a gain of £11 10s. What did he get for each sheep?

THIRD QUARTER.

1. How many days, &c., are there in a million and a half seconds?

2. To how many persons could £1 2s. 8d. be given out of £173 8s.?

3. What would a bushel of strawberries cost at 4d. a pint?

4. How many tons of soap must be sold at 3½d. per lb. to realise £98?

STANDARD V.—FIRST QUARTER.

1. What is the value of 17,958 articles at £17 9s. 5½d. each?

2. A farmer had 3 stacks of hay, each weighing 19 tons 15 cwt. 1 qr. He sold them at £5 15s. per ton. How much did he receive for them?

3. What is the cost of 78,030 tons of coals at 11s. 8½d. per ton?

4. How much do 284 bins contain, each holding 7 qrs. 3 bus. 1 pk.?

SECOND QUARTER.

1. What will 4 ac. 2 ro. produce if 9 ac. 3 ro. produce 208 bushels?

2. What will be the rent for 35 weeks 5 days at 15s. 9d. per month of 4 weeks?

3. A servant receives £20 wages for 8 months. How much will she save in a year, if she spends £1 6s. 9d monthly?

4. What would be the cost for the following? Making 7 shirts at 1s. 9d. each; making 13 pairs of stockings at 8½d. per pair; making 19 pairs of socks at 6½d. per pair; 6 days 5 hours work (9 hours a day) at 4½d. per hour; 5 days 6 hours work (8 hours a day) at 3s. per day.

THIRD QUARTER.

1. Take $(\frac{3}{4} + \frac{5}{8})$ from $(\frac{2}{3} + \frac{5}{6})$.

2. Two coaches start in the same direction at the rates of 7½ miles and 6¾ miles per hour. How far will they be apart in 18 hours?

3. Simplify $1 - (\frac{1}{6} + \frac{1}{7} + \frac{1}{8} + \frac{1}{9})$.

4. After spending $\frac{2}{5}$ of my money, I had 12s. 6d. left. How much had I at first?

STANDARD VI.—FIRST QUARTER.

1. Simplify $(4\frac{3}{8} \div 1\frac{1}{6})\ (5\frac{2}{9} - 4\frac{5}{12})$.

2. How many times can $\frac{3}{7}$ of $\dot{3}\dot{8}$ be taken from $9\dot{8}\dot{3}$?

3. Divide £36 17s. 8½d. by $3\frac{7}{16}$.

4. Simplify

$$\frac{\cdot036 + \cdot029}{\cdot0039} \times \frac{\cdot05}{\cdot016}$$

SECOND QUARTER.

1. Add ·625 of a crown, ·61 of a guinea, and 2·85 of £2 10s.

2. If the cost of 27 yds. 1 ft. 10 in. of cloth was £6 4s. 3d., what was the cost per yard?

3. If £2·4375 be copied instead of £24·375, what is the amount of the error?

4. If $\frac{5}{9}$ of an estate is worth £960, what is the value of $\dot{2}\dot{5}\dot{9}$ of the estate?

THIRD QUARTER.

1. Find the amount of £1,520 16s. 8d. for 2 years 96 days at $4\frac{1}{2}$ per cent.

2. Reduce $\frac{7}{8}$ of $\frac{6}{11}$ of 100 yards to the fraction of $3\frac{1}{4}$ miles.

3. At what rate per cent. will £450 amount to £513 in 4 years?

4. My income is £480, and is reduced by income-tax to £473 2s. 6d., but £150 is exempt from taxation. What is the income-tax in the £?

STANDARD VII.—FIRST QUARTER.

1. A boy can empty a cistern in $1\frac{3}{4}$ hours, and another boy can empty it in $1\frac{1}{4}$ hours. How many minutes will it take them together?

2. If £350 gain £24 10s. in $4\frac{1}{2}$ years, how much will £260 gain in $3\frac{3}{4}$ years?

3. In a town of 7,960 voters, ·35 voted for one candidate and ·275 for the other; how many abstained from voting?

4. If the 4d. loaf weigh $4\frac{1}{4}$ lbs., when flour is 1s. 8d. per peck, what is the price of flour per peck, when the 3d. loaf weighs $2\frac{1}{2}$ lbs.?

SECOND QUARTER.

1. What is the average price per lb. of $13\frac{1}{2}$ lbs. of tea at 2s. 4d. per lb., $26\frac{1}{4}$ lbs. at 2s. 8d. per lb., $15\frac{1}{2}$ lbs. at 3s. 6d. per lb., and $4\frac{3}{4}$ lbs. at 3s. per lb.?

2. Simplify:—

$$\frac{3\frac{1}{3} \text{ of } \frac{4}{5} + \frac{3}{8} \text{ of } 10}{\frac{5}{6} \text{ of } 2\frac{1}{4} + 4\frac{1}{3} \text{ of } \frac{5}{39}} \div \frac{\frac{1}{3} + \frac{1}{4}}{\frac{1}{3} - \frac{1}{4}}.$$

3. What sum will gain £17 8s. in 87 days at 4 per cent.?

4. A train travels at the rate of 30 miles per hour for 40 minutes, and then at the rate of 25 miles an hour for 24 minutes. What was the average rate per hour for the whole time?

THIRD QUARTER.

1. If £450 was divided among A, B, and C, and A received $27\frac{1}{2}$ per cent. and B $38\frac{3}{4}$ per cent., how much did C receive?

2. What sum diminished by 15 per cent. of itself gives £2 19s. 6d.?

3. What income is derived from investing £1,516 11s. 3d. in 4 per cent. railway stock at $105\frac{1}{2}$?

4. A shopkeeper marks his goods 30 per cent. above cost price, and allows 4 per cent. for cash. What is his percentage of profit?

ANSWERS.

STANDARD I.

	First.	Second.	Third.
1.	844.	1,627.	1,547.
2.	561.	508.	169.
3.	303.	677.	98.
4.	765 eggs.	38 years.	50 nuts.

STANDARD II.

	First.	Second.	Third.
1.	28,209.	9,876.	9,657.
2.	97,845	68,763,060.	20,933,613.
3.	5,620,550.	897.	7,849.
4.	314 oranges.	656 eggs.	20 miles.

STANDARD III.

	First.	Second.	Third.
1.	68,075 times.	£19,979 19s. 10½d.	£77,714 9s. 5½d.
2.	1,640 + 72.	£3,089 1s. 4½d.	3s. 10d.
3.	756.	36 wagonettes.	£42,918 12s. 7½d.
4.	3,797,157.	6d.	£2 4s. 6d.

STANDARD IV.

	First.	Second.
1.	£52,292 5s. 8¼d.	11 miles 6 fur. 6 chains 21 yds. 1 ft.
2.	17s. 11¾d.	4,745 florins.
3.	£67.	468 parcels.
4.	£367 15s. 8½d.	£3 15s.

	Third.		
1.	17 days 8 hrs. 40 min.	3.	£1 1s. 4d.
2.	153 persons.	4.	3 tons.

STANDARD V.—FIRST.

1.	£313,778 12s. 9d.	3.	£45,680 1s. 3d.
2.	£340 18s. 0¾d.	4.	2,103 qrs. 3 bus.

SECOND.

1. 96 bushels.
2. £7 0s. 7½d.
3. £13 19s.
4. 12s. 3d. + 9s. 2½d. + 10s. 3½d. + £1 2s. 1½d. + 17s. 3d. = £3 11s. 1½d.

	Third.		
1.	$\frac{11}{12}$.	3.	$\frac{2}{3}\frac{3}{3}$.
2.	$13\frac{1}{2}$ miles.	4.	£1 0s. 10d.

STANDARD VI.

	First.	Second.	Third.
1.	$3\frac{1}{11}$.	£7 18s. 5½d.	£1,675 14s. 2d.
2.	59 times.	4s. 6d.	$\frac{105}{12,584}$.
3.	£9 19s. 4$\frac{3}{4}$d.	£21 18s. 9d.	$3\frac{1}{2}$ per cent.
4.	52·083.	£448.	5d.

STANDARD VII.

	First.	Second.	Third.
1.	$43\frac{1}{7}$ min.	2s. 10d.	£151 17s. 6d.
2.	£15 3s. 4d.	$\frac{382}{1,225}$.	£3 10s.
3.	2,985.	£1,825.	£57 1cs.
4.	2s. 1½d.	$28\frac{1}{2}$ miles.	$24\frac{1}{2}$ per cent.

Tests in Mental Arithmetic.

STANDARD I.

1. What number must be added to 14 to make a score? 6.
2. What must be added to make two dozen? 10.
3. What is the half of half a dozen? 3.
4. What is the half of half a score? 5.
5. Out of a bag of marbles containing fifty 20 are taken out twice. How many remain? 10.
6. If 10 were taken out twice, how many would remain? 30.
7. What is the cost of 4 dozen oranges at a halfpenny each? 2s.
8. How much would they cost at 3 a penny? 1s. 4d.
9. How many halfpennies could you get for 1s. 4d.? 32.
10. How many more are wanted to make 50? 18.
11. If 6 books cost 18s., how much is that for each book? 3s.
12. How many books could you get for a sovereign and a shilling? 7.

STANDARD II.

1. How many must you add to 3 score to make half a gross? 12.
2. How many must you add to 7 score to make a gross? 4.
3. How many half-dozen are there in a gross? 24.
4. A boy has 24 marbles and he wins 9. How many more does he want to have two score? 7.
5. What is the third of half a dozen? 2.
6. What is the fifth of half a score? 2.
7. A boy is sent with half-a-crown to change into halfpennies. If he brings back only 57, how many is he short? 3.
8. If 3 lbs. of sugar cost 6d., how much would 4 lbs. cost? 8d.
9. How much would $5\frac{1}{2}$ lbs. cost? 11d.
10. Divide 6d. between two boys giving one a penny more than the other. $3\frac{1}{2}$d. and $2\frac{1}{2}$d.
11. If a train travels 5 miles in 10 minutes, how far can it go in an hour? 30 miles.
12. How far can it go in 15 minutes? $7\frac{1}{2}$ miles.

STANDARD III.

1. Multiply a tenth of 280 by an eighth of 32. 112.
2. Take 112 from 10 score. 88.
3. Two trains start in opposite directions at the rates of 25 and 30 miles an hour. How far will they be apart in two hours? 110 miles.
4. If they travel in the same direction, how far will they be apart? 10 miles.
5. If the quotient is 25, the divisor 20, and the remainder 6, what is the dividend? 506.
6. If the dividend is 938, what is the remainder? 18.
7. What is the cost of a thousand eggs at 25 for a shilling? £2.
8. A man earns £2 weekly. How much is that per day, working 6 days a week? 6s. 8d.
9. How much is it per hour, working 10 hours a day? 8d.
10. What would 20 lbs. cost at $2\frac{1}{2}$d. per half-pound? 8s. 4d.
11. How many lbs. are there in $1\frac{1}{2}$ cwt.? 168.
12. What would $1\frac{1}{2}$ cwt. cost at a halfpenny a lb.? 7s.

STANDARD IV.

1. What will 5 yds. 2 ft. cost at 6d. a yard? 2s. 10d.
2. If 9 horses cost £405, what is the cost of one? £45.
3. If I spend 30s. weekly, how much do I spend in a year? £78.
4. Divide a florin equally among 5 boys and 3 girls. How much will each one get? 3d.
5. If a lb. of tea cost 2s. 6d., what will $1\frac{1}{4}$ lbs. cost? 3s. $1\frac{1}{2}$d.
6. If 8 lbs. of beef cost 6s. 8d., what will $\frac{3}{4}$ lb. cost? $7\frac{1}{2}$d.
7. How many yards of calico at $7\frac{1}{2}$d. per yard could you get for 10s.? 16.
8. What is the cost of 57 articles at 6s. 8d. each? £19.
9. If a boy saves $1\frac{1}{2}$d. a day, how long will it take him to save half a sovereign? 80 days.
10. If he commences on the 1st of August, when will he have that amount? (October 19th.)
11. Divide 20 into two parts, so that one part exceeds the other by 4. 12 and 8.
12. If a ton of potatoes costs £8, how much will a stone cost? 1s.

STANDARD V.

1. A boy eats $\frac{2}{5}$ of a cake. How many tenths has he left? 6.
2. How many fifteenths has he left? 9.
3. What is the difference between $\frac{1}{10}$ and $\frac{1}{15}$? $\frac{1}{30}$.
4. What is the sum of $\frac{1}{10}$ and $\frac{1}{15}$? $\frac{1}{6}$.
5. If a tenth of a cake is given to one boy and a fifteenth to another, how much remains? $\frac{2}{3}$.
6. What is the difference between $\frac{1}{4}$ of 10s. and $\frac{1}{5}$ of a crown? 10d.
7. A train runs at the rate of 40 miles an hour. How far will it go in 10 minutes? $6\frac{2}{3}$ miles.
8. An article is bought for 12s. 6d., and sold at a gain of $\frac{1}{10}$ of the cost price. What is the selling price? 13s. 9d.
9. If $\frac{1}{10}$ was lost, what would be the selling price? 11s. 3d.
10. What is the amount of £500 for 5 years at 5 per cent.? £625.
11. Express $\frac{1}{8}$ of $\frac{1}{4}$ as a decimal. ·125.
12. What is 6 times this decimal? ·75.

STANDARDS VI. AND VII.

1. What decimal must be added to $\cdot\dot{1}\dot{6}$ to make it into unity? $\cdot\dot{8}\dot{3}$.

2. What decimal must be taken from $\frac{1}{6}$ to leave $\cdot\dot{1}\dot{6}$? $\cdot\dot{0}\dot{3}$.

3. What decimal of 2s. 3d. is 1s. 3d.? $\cdot\dot{5}$.

4. What is the average of the numbers from 1 to 6? $3\frac{1}{2}$.

5. A gentleman gave $\frac{3}{4}$ of $\frac{9}{10}$ of an estate to his son and the remainder to his daughter. If the estate was worth £4,000, what was the value of the daughter's share? £1,600.

6. In a school 30 per cent. were absent, and 280 were present. How many attended the school? 400.

7. The attendance at a school rose from 400 to 450. What was the increase per cent.? $12\frac{1}{2}$ per cent.

8. If it had increased 20 per cent., what would have been the attendance? 480.

9. If discount is allowed of 2d. in the shilling, what percentage is that? $16\frac{2}{3}$ per cent.

10. By selling a watch for £5 10s., 10 per cent. is gained. What is the cost price? £5.

11. If sold for £5 15s., what would be the gain per cent? 15 per cent.

12. If £120 amounts to £144 at 4 per cent., how long has it been in the bank? 5 years.

—o—

An Elementary Course in the Use of Wood Working Tools.

BY FRED. WILKINSON, F.G.S.,

Science Teacher under the Bolton School Board.

WE dealt with the ripping and cross-cutting saws in our last paper, and we worked one or two exercises upon them. We shall next try one more exercise on the ripping saw, and then pass on to the next important form of saw, viz., the tenon or back saw.

EXERCISE XV.

To saw a block diagonally as shown in fig. 70.

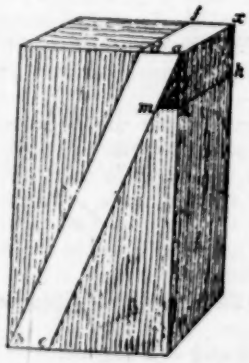

Fig. 70.

We are required then in this exercise to cut away by means of the saw the part shaded lightly in fig. 70. We set to work to do this in the following way. From point *a* mark off one inch, and from point *b* mark off one inch. Draw the lines *ac* and *bd*. Square over *df*, and do the same on the lower side.

Now by means of the ripping saw we are required to saw down *ac* and *db*.

There are two good ways by which we may do this. We can saw a line *mnh*, as shown in the figure, and remove the part shaded thicker than the rest by means of the chisel, but as we have not had any exercises upon this tool we fall back upon the second method, viz., sawing it through. The author acknowledges here the great help received while a student under Mr. Trainor, at the Technical School, Manchester, especially in the manipulation of the saw, chisel, and plane. His course was excellent in every way. The pupil will find it a difficult matter to produce a kerf along the line *ax* (being the edge) without some assistance. This we obtain by placing another block in the vice alongside the block upon which we are working. The two are shown in position in the vice in fig. 71.

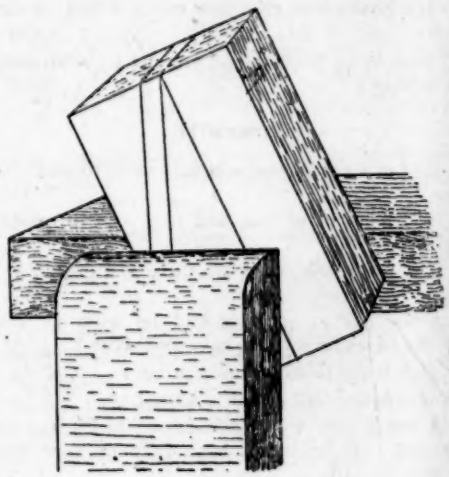

Fig. 71.

We have then, by adopting this position, very little difficulty in forming a kerf along the line *ax*, because of the aid rendered by the application of the second block.

We then saw down the line and reverse when we get to the vice. Then remove left hand portion in a similar way.

In sawing exercises whenever it is possible saw in a plane vertical or at right angles to the top of the bench, which in this case is a horizontal plane. Greater accuracy will always result if attention be paid to this important instruction. The pupil will also find that he has greater control of the saw when this position is maintained.

Tenon or Back Saw.—On taking up this saw we notice that it differs from the cross and ripping saw in many particulars. We will next describe the most important of these differences.

The ripping and cross saws taper from the handle to the head. The tenon saw is the same width all along (see fig. 72).

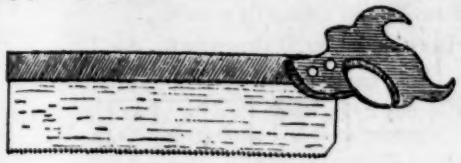

Fig. 72.

The ripping and cross saws are longer than the tenon saw. They have also the apices of their teeth further apart than the tenon saw. The thickened triangles in fig. 73 represent the teeth of the cross

Fig. 73.

saw. The dotted triangles represent the teeth of the tenon saw. We see, therefore, that in the tenon saw the teeth are brought forward as it were and we find as the result of this, that it increases the saw's efficiency and the thrusting of the saw is augmented by this simple arrangement of the teeth.

In the ordinary tenon saw we usually find about 16 teeth to an inch. One result of this increase in the number of teeth will be to hinder its cutting action on the fibres, and we find that it does not do its work so rapidly as the cross cut or the ripper.

On referring to fig. 72 again we notice what is known as the back of the saw. It may be made of iron or brass. In the better saws it is generally made of brass.

The obvious use of this is to give strength to the blade. If this were removed and the saw were made of the same width all along it would fail in its work. This weakness however is avoided by a back as we have shown.

We now see, too, why it is called 'a back saw.' The blade is usually very thin, and fine work may be done by it. Because it is most frequently used for the production of tenons it is named also 'a tenon saw.'

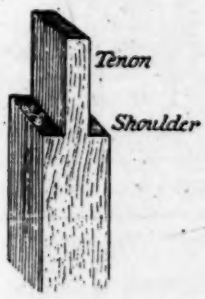

Fig. 74.

Fig. 74 shows us what is known as a 'tenon' in wood-working, and as this particular form can be produced very readily by this kind of saw it is named shortly 'a tenon saw.'

EXERCISE XVI.

To cut a block which has been trued up to 8 inches by 2 inches by 2 inches into 4 blocks of 2 inches side or 4 cubes of 2 inches side.

This may be easily accomplished by using the tenon saw, but before we can perform this experiment successfully we shall require the assistance of some tool to keep the block in position while we are sawing it. We now make the acquaintance of another exceedingly useful appliance known technically as a 'Bench Hook.' It is so called because it really hooks or attaches itself to the bench when placed in a certain position. Fig 75 shows the form of bench hook commonly used.

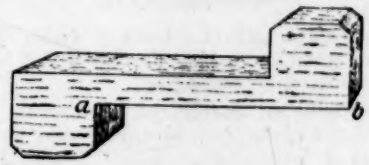

Fig. 75.

The plane, one edge of which we see along *ab*, rests upon the bench in a horizontal position, see fig. 76.

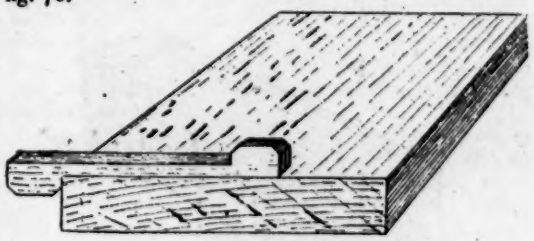

Fig. 76.

The object to be sawn is placed upon the upper side of it and rests on it. The hook is kept in position on the bench by the lower horn of the hook.

Now place the block upon the hook, and having squared the block and got it the right length, cut through the marks. Fig. 77 shows how block should be held in position by the left hand.

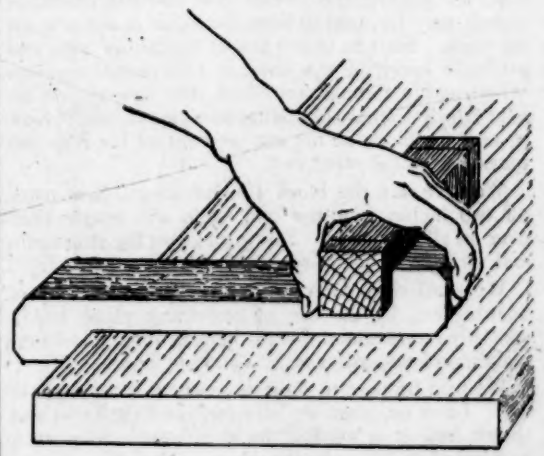

Fig. 77.

Begin at the further edge and gradually assume a horizontal position, keeping the eye well upon the vertical lines on the far side.

If this exercise is well done, 4 good cubes will be the result. Fig. 78 shows the block ready for cutting.

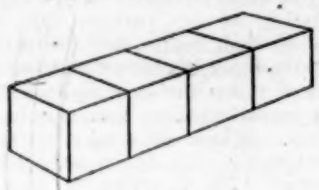

Fig. 78.

EXERCISE XVII.

To square two ends of a block of wood. We take a piece of wood and work it down to 2 inch sides and say it is about 5 inches long.

Now suppose we are required to square the ends by means of tenon saw and set square, and we want a block say 4 inches long. This will necessitate the cutting of a portion from each end so as to leave the block 4 inches long.

Square over a line about ½ inch from one end and square over on all four sides. Now measure the 4 inches and square over the lines at the other end.

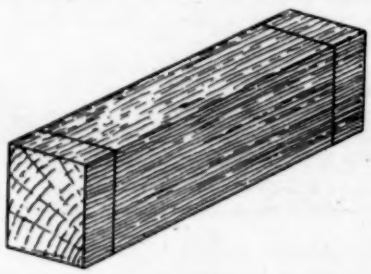

Fig. 79.

Fig 79 shows the block ready for putting upon the block and sawing. Reference to fig. 77 shows the student how to place the block upon the hook. See that the bench hook is firmly placed upon the bench. The thumb may conveniently be used for guiding the saw at first, and afterwards the thumb may be used to keep the block in position on the hook. Start as before first at the farther edge and gradually lower the saw down to a horizontal position. When nearly through the block, the saw should be held lightly so that splintering may be avoided. Now reverse the block on the stop and cut off the required portion from the other end.

We have now the block 4 inches long. Now mark off two inches from the end again and square lines over on all four sides. Saw through on the stop again and we have as before two cubes of two inches side.

We shall show later on how to square the ends of boards, &c., by the use of smoothing plane and a specially constructed board known among cabinet-maker, and carpenters as a 'Shooting Board.'

We next propose to show how to cut at an angle of 45°. Later on, when we have explained the bevel and shown how it is applied, we shall be able to work a number of exercises by its aid.

EXERCISE XVIII.

To cut through a block at an angle of 45°. True up a block and square the ends as already shown to 10 inches by 2 inches by 2 inches.

Draw lines over as shown in fig. 80.

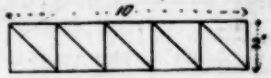

Fig. 80.

Square the lines over on all four sides, on the top side draw the diagonals as shown in fig. 80 and draw lines similarly on the bottom side.

When the blocks are cut through, the accuracy of the exercise may be tested by looking at the lines underneath. If the sawing be badly done the lines will be seen, but if well done the lines will not be visible.

The lining should be done by the scriber and not by lead.

The drawing of the diagonal will give us lines at 45° to the face. The most expeditious method would have been that of using the bevel, but as we have not used this tool we pursue the above method as preliminary.

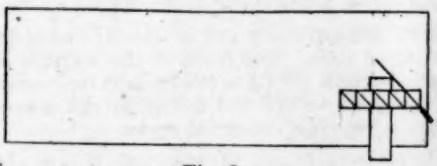

Fig. 81.

In fig. 81 we have a plan of the bench hook, block, and saw. It will be observed the right hand end of the block hangs over the hook so as to let the saw work freely and not to let it come in contact with the stop. Fig. 82 gives a good idea of the position of the block preparatory to sawing.

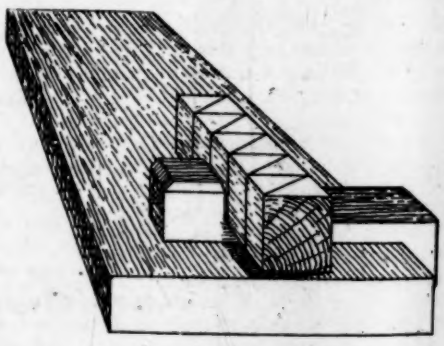

Fig. 82.

Press the block firmly against the bench and then insert the saw as before, but now saw at the angle named. Keep the eye on the far side to see that the line is covered all the way down.

When each cut is nearly finished, lightly hold the saw and do not unduly force it through, so that the blocks may not be torn on the edges.

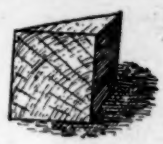

Fig. 83.

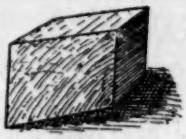

Fig. 84.

In figs. 83 and 84 we have drawings of the pieces cut. These should be kept for future reference.

EXERCISE XIX.

To make a plain box, similar to one shown in fig. 85.

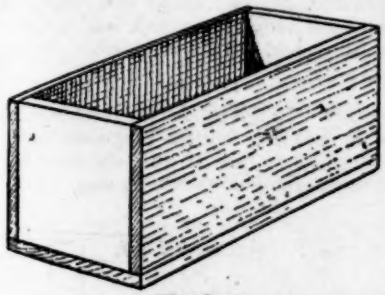

Fig. 85.

Now, before we can proceed directly to make the box, we shall have to refer again to the jack plane. It is generally used, as we said very early, in working over wood with the sole upon the planed surface. It can, however, be used in other ways. It may be used by fixing it in the vice as shown in fig. 89

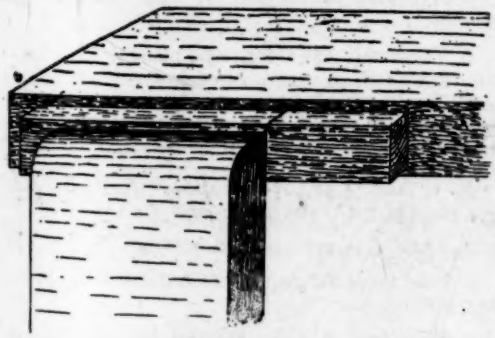

Fig. 86.

When this method is adopted it is usual to run the slip to be planed upon the sole of the plane.

A better method is to put the board in the vice and use the plane in the ordinary way.

Now suppose we have to smooth the end of a board after it has been sawn.

By using what is known as a shooting board our difficulty disappears, and we are able to smooth the ends with the greatest facility.

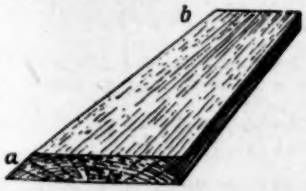

Fig. 87.

Fig. 87 shows a board with the edge marked *ab* at an angle of 45°.

By using the shooting board we can obtain this face quite easily.

We will now proceed to show in the following exercises:—

1. How to shoot edge of a board.
2. How to shoot end of a board.
3. How to obtain side at an angle.

It will be well before we proceed to work the three exercises to explain the construction of this piece of apparatus. Fig. 88 gives a fair idea of what it is like.

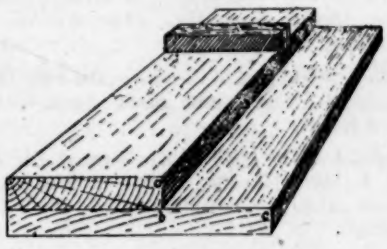

Fig. 88.

It consists really of two boards, one 3 or 4 inches wider than the other—the lower about 10 inches wide and both 3 feet long. These are made perfectly true. The angle *abc*, in fig. 88, must be a right angle, and this cannot be obtained unless the surfaces are perfectly trued.

Near the top end we have another piece about $1\frac{1}{4}$ in. or $1\frac{1}{2}$ in. in width, and of the same length as the width of the upper of the two boards just mentioned. This may be laid on the top, or a trench may be made at right angles to the edge of the upper board.

In the author's shooting board a trench has been made and the short piece fitted into it. It may be screwed or glued into position when the cutting in which it lies is finished properly. The plane is laid on its side, and the board to be shot is laid as shown in fig 19, which is a plan of bench, plane, board and block we are planing. With the left hand the board is held in position, and with the right hand the plane is worked forward and backward.

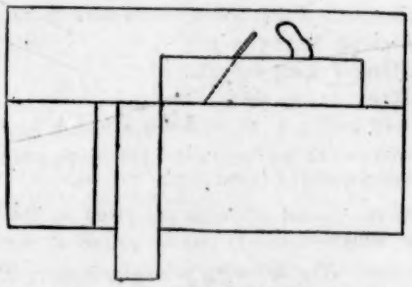

Fig. 89.

The edges of boards may be made very smooth and true in this way.

(To be continued.)

How my School was Examined.

BY THE HEAD MASTER OF A WEST OF ENGLAND SCHOOL.

STANDARD I.

Arithmetic.—1. Add 9; 29; 635; 24; and 404.
2. From 950 take 302.
3. Take 97 from 955.
Answers—(1) 1,101; (2) 648; (3) 858.

Writing.—The following words were dictated: *Window, Master, Book, Field, Plate, Hillside, Stable, Table, House, Tail.*

Reading.—One part of the class read from Blackie's Geographical Reader, the other from Chambers' Standard Reader.

Repetition.—The children had learned *The Voice of Spring*, by Mrs. Hemans. After reciting the lines, they were asked for meanings of all difficult words and phrases.

Mental Arithmetic.—How many are 9 and 6? 4 nuts, 8 nuts, and 7 nuts? I had 15 marbles and lost 8; how many had I left? I had 9 marbles in one pocket, and 8 in another, how many altogether?
The class was fully questioned also on the tables.

Geography.—A plan of the room was placed before the class. The Inspector, pointing to various marks on the plan, asked what they represented, and followed this up by such questions as the following:—
What is outside the school?
How can you find the north?
When the north is found, how can the south, east, and west be found?
Standing with my back to the east, where is the north, the west, the south?
The children were then taken into the large room of the school, an oblong was drawn on the black-board, and each child was required to fix with a pointer the position on the plan of various objects on the floor, such as the master's desk, the harmonium, the gallery.

STANDARD II.

Arithmetic.—The following sums were dictated:—
1. Multiply 80,705 by 308.
2. Multiply 9,487 by 946.
3. Divide 14,059 by 7.
4. Add 50,803 + 76 + 8,009 + 650 + 87 + 658.
Answers—(1) 24,857,140; (2) 8,974,702; (3) 2,008 + 3 over; (4) 60,283.

Reading.—Great attention was given to the words and meanings.

Writing.—The following passage was dictated from Chambers' Second Standard Reader, page 69:—

'A poor man, who had been blind for many years, was walking along the high-road, feeling his way with his stick. "How unhappy I am," he said to himself, "to have been obliged to leave my poor little dog at home ill! I thought for once I could have found my way to the next village without him."'

Mental Arithmetic.—Such exercises as the following were given:—2 × 2; 9 × 9; 8 × 8; 3 × 7; 3 × 3. How much is 96 pence? 101 pence? 20 pence? How many pence in 1s. 8d.? In 2s.? In 2s. 1d.? In 3s. 3d.? 3 books at 1½d. each? 2 books at 2½d. each? What remains if 1s. 8d. be taken from 2s.? 9 marbles, 4 marbles, and 2 marbles? Take 21 from 37; 24 from 40. Multiply 45 by 2; 25 by 3.

English.—For repetition the children had learned '*A Night with a Wolf*,' by Bayard Taylor. As in reading, particular attention was given to meanings and allusions.

For grammar, reading books were given out, and each child was required to pick out a verb from a selected paragraph. What is a verb? What part of speech is *are*?

Geography.—In this subject the teacher was allowed to question the class; but the Inspector occasionally asked questions to see if the children had fully grasped the meaning of the definitions.

STANDARD III.

Arithmetic.—Typical cards.

A. 1. Add £406,321 16s. 1½d.; £32,514 2s. 11¾d.; £462 0s. 3½d.; 10s. 11½d.; and £118,721 10s. 9¾d.

2. Find the difference between £40,321 14s. 7d. and £90,625 18s. 10½d.

3. Divide nine millions eight hundred and thirty thousand and twenty-one by nine hundred and seventy.

4. There were 982 trees to be planted in 19 fields; sixty-four of them were planted in one field; and the rest equally divided among the remaining fields. How many trees were there in each of the remaining fields?

B. 1. Add £32,401 12s. 10d.; £42 16s. 9½d.; £4,260 13s. 7d.; 18s. 7½d.; and £4,206 3s. 9¾d.

2. From £32,406 14s. 2½d. subtract £98 17s. 3½d.

3. Find the difference between thirty thousand and one million.

4. John has 7s. 2½d.; William has 3s. 6½d. more than John. How much have they together?

C. 1. Divide 103 012 by 850.

2. Add £34,697 14s. 6½d.; £321 14s. 6d.; £483 14s. 10½d.; £32,413 17s. 2d.

3. From £32,406 13s. 6d. take £210 5s. 0½d.

4. Half of a man's weekly wages was equal to the sum of 4s. 8d., 1s. 11½d., 1s. 6d., and 2s. 6d. How much did he earn in a week?

Answers—

A. (1) £558,020 1s. 2d.; (2) £50,304 4s. 3½d.; (3) 10,134 + 41 over; (4) 51 trees.

B. (1) £40,912 5s. 7¾d.; (2) £32,307 16s. 11d.; (3) 970,000; (4) 17s. 11½d.

C. (1) 121 + 162; (2) £67,917 1s. 1d.; (3) £32,196 8s. 5½d.; (4) £1 1s. 3d.

Writing.—The following passage was dictated:—

'Within, round the embers of yesterday's fire, lay three children, sleeping. The curly head of the youngest rested on the shoulder of his eldest brother, his delicate face and childish limbs contrasting well with those of his sturdy protector. The other boy was lying a short distance from these two, rolled up in a woollen cloth that concealed him from view.'

English.—Grammar was taken orally, and such questions as the following were asked, all being based on the poetry: What part of speech is 'his'? Why? Mention a verb. Why is it a verb? What is the word 'me'? Why? What is 'eye'? Why? What is 'quoth'? Why? What is 'you'?—'I'?—'breakers'? 'warning'?

Geography.—The following questions were asked: What county do you live in? Where is it? What kind of country is it? What does *maritime* mean? What rivers are in Devonshire? Where does the Exe rise? What town is on its banks? Where would you go to see the river Avon? What mountains are in Devon? What is Dartmoor noted for? Where is the white clay of Devonshire sent? Where besides North Stafford? Is the river Dart the prettiest river? Name another pretty river? Where is the river Wye? What town is at the mouth of the Dart? What town is opposite Dartmouth? What railway runs through Devon? What rivers flow into Barnstaple Bay? Name a town on their banks. What watering places are in Devon? What fishing town? What is the capital of Devon? What point is noted on the south coast? What forms the boundary between Devon and Cornwall? Name a town at its mouth?

What are the chief manufactures of England? Which are the principal towns engaged in the woollen manufacture? Where is the woollen manufacture carried on besides in Yorkshire?

Name the longest rivers in England? Name the tributaries of the Severn. Where does it rise? Who was born at Stratford? Name some of the works of Shakespeare. What do we call them? Name a town on the Lower Avon.

STANDARD IV.

Arithmetic.—Specimen cards:—

A. 1. Multiply £690 17s. 11½d. by 819.

2. Reduce 205 miles 3 fur. 16 pls. 2 ft. to feet.

3. Two hundred and eighty miles of railway cost £141,085; what would one mile cost?

4. A man's yearly income is £1,500. He saves £277 5s. How much does he spend daily?

B. 1. Multiply £479 19s. 0¼d. by 989.

2. Bring half a million quarts to quarters.

3. How many parcels weighing 10 lbs. each can be made out of 10 tons 10 cwts. 80 lbs.?

4. How many lbs. of coffee at 1s. 4d. per lb. can I have in exchange for 15 cwt. 2 qrs. of tea at 2s. 6d. per lb.?

C. 1. Reduce 69 miles 4 fur. 17 poles 5 yds. to feet.

2. Divide £900,060 12s. 0¼d. by 275.

3. How many half-ounce packets can be made out of 201 cwts. of tobacco?

4. What is the value of 16 pieces of cloth, each measuring 60 yards, at the rate of £2 16s. per dozen yards?

D. 1. Multiply £9,087 13s. 11¼d. by 619.

2. Reduce 665,280 feet to furlongs.

3. From one million pounds take £935,500 13s 10¾d., and divide the remainder by seven.

4. In a school there are 700 scholars. One half pay 3d. and the rest 4d. each per week. What will the fees amount to in 4 weeks?

Answers.—*A.* (1) £565,845 7s. 10½d.; (2) 1,084,644 ft.; (3) £503 17s. 6d.; (4) £3 7s.

B. (1) £474,671 11s. 7½d.; (2) 1,953 qrs. 1 bus.; (3) 2,360 parcels; (4) 3,225 lbs.

C. (1) 367,255½ ft; (2) £3,272 18s. 11¼d. + 202; (3) 720,384 packets; (4) £224.

D. (1) £5,625,284 7s. 3¾d.; (2) 1,008 furlongs; (3) £9,214 3s. 8¾d.; (4) £40 16s. 8d.

Writing.—The following passage was dictated:—

'The men wore long gowns when not in armour, and had hoods for their heads with peaks behind, and the sleeves were finished with streamers. The toes of their shoes were constantly made longer, twisted like ram's horns, finished like the beaks of birds, and sometimes turned up and chained to the knee. There was much delight in tilts and tournaments, and these were conducted with the utmost pomp and splendour.'

Grammar.—This was tested by parsing of the following sentences:—'

a. We learn to reverence him for his wisdom.

b. A passing attack of an old malady laid her by for a time.

c. In a spirit of truth she determined to try again.

d. She dared not speak again to her enraged father.

e. Children ought always to speak respectfully to their parents.

f. The rules of the school are formed for the pupils' good.

Mental Arithmetic.—How many lbs. in 1 cwt.? How many in half a cwt.? How many in 1½ cwts.? ⅛ of £1? ⅞ of £1? ⅛ of 1 lb.? ⅞ of 1 lb.? ⅛ of 1s.? ⅞ of 1s.? How many hats at 2s. 6d. would you get for £2? If oranges were 2 for 1½d., how many would you get for 1s.? If they were 3 for 2d., how many would you get for 1s.? Which is the cheaper of the two? How many would you gain by having 6d. worth of the cheaper?

Geography.—Most of the questions were asked on Australia. Have you any friends gone out to Australia? To which part are they gone? Where is Adelaide? What is Sotuh Australia noted for? Do we grow enough wheat to supply ourselves? Where do we export it from? Which is the oldest colony? What is its capital? What is New South Wales noted for? What is exported from it? Which is the youngest colony? What is its capital? Name another town there? What made Australia so rich?

Which colony is richest in gold? Where are the gold mines? What forms the boundary between Victoria and New South Wales? Name its tributaries. What is the capital of Queensland? What is produced in Queensland? Where are the mountains principally? Name them. If coming from England which colony would you first come to? What was Australia once used for? Name the place that was most noted for landing convicts.

Questions were also asked on the manufactures of Ireland and Scotland.

STANDARD V.

Arithmetic.—Specimen cards:—

A. 1. Find the total amount of the following:—184 articles at £1 19s. 11½d. each, and 378 articles at £1 19s. 11½d. each.

2. What will 2 tons 18 cwt. 14 lbs. of coal cost at £1 per ton?

3. What amount will a tax of £15 6s. 3d. represent at 7d. in the £?

4. Make a bill for—7¼ lbs. of tea at 3s. 6d. per lb.; 1 cwt. of soap at 3½d. per lb.; 7 gallons of oil at 5d. per qt.; 3 hams, each 15¾ lbs., at 7¾d. per lb.; 720 eggs at 6 for 5d.

B. 1. Find the value of $(\frac{2}{3} - \frac{1}{2}) + (\frac{1}{2} - \frac{1}{5})$.

2. Find the value of 354 days' work if 2½ guineas are paid for every week of 6 days?

3. During a term of 12 weeks a man receives £2⅛ more than the £25 which he spends. How much does he save in 30 weeks?

4. Make a bill for 2¼ lbs. of tea, at 3s. 6d. per lb.; 1 cwt. sugar, at 3½d. per lb.; 18 caps, at 1s. 2d. each; 2 hats, at 10s. 1d. each; 4 ozs. of coffee, at 1s. 8d. per lb.

C. 1. $\frac{1}{2} + \frac{1}{3} + \frac{1}{4} - \frac{3}{10}$.

2. Find the cost of 496 men's suits at £3 11s. 8d. each.

3. If a man pays 5s. in the £1, and still owes £500, what did he owe at first?

4. Make a bill for 25 books at 4½d. each; 25 ditto at 10½d. each; daily paper published at 1d. for 120 days, with ½d. postage for each paper; 25 volumes at 1s. 3d. per volume.

Answers—*A.* (1) £1,122 16s. 7d.; (2) £2 18s. 1½d.; (3) £525; (4) £1 5s. 4½d. + £1 12s. 8d. + 11s. 8d. + £1 10s. 6d. + £2 10s. = £7 10s. 2½d.

B. (1) $\frac{1}{3}$; (2) £154 17s. 6d.; (3) £5 10s.; (4) 7s. 10½d. + £1 12s. 8d. + £1 1s. + £1 0s. 2d. + 5d. = £4 2s. 1½d.

C. (1) $\frac{17}{60}$; (2) £1,777 6s. 8d.; (3) £666 13s. 4d.; (4) 9s. 4½d. + £1 1s. 10½d. + 10s. + 5s. + £1 11s. 3d. = £3 17s. 6d.

Writing.—The following stories were read for alternate children to reproduce in their own words:—

A. 'A tailor in Berlin was in pecuniary difficulties, but wanted to get to Paris to obtain work. He made a large box with a lid, and a bolt inside. In the bottom of it he put some straw, a bottle of water, and some biscuits, and having labelled it on the outside—"Paris, Express Train," he went to the luggage office and stated that he had a large box which he wished to be taken to the railway station. As soon as he saw the officials coming to his house he jumped into the box and fastened the lid on the inside. After about 60 hours' travelling the box was put on the platform at Paris, and the tailor prepared to leave. He was, however, caught, and was afterwards prosecuted for trying to cheat the railway company.

B. Some travelling Germans arrived at the port of Hull with a performing bear. While the men were refreshing themselves at an inn, Bruin managed to escape. He was pursued by some farmers, who drove him into a wood, where he lay concealed. The owners of the animal also made their escape, fearing that they would be prosecuted by the authorities for not taking more care to keep the dangerous beast under safe control.

Grammar.—Two sentences were given for parsing and analysis:—

A. Any intention of leaving the ship was never entertained.

B. To make the ascent we arose early next morning.

Mental Arithmetic.—In $\frac{1}{3} + \frac{1}{2} + \frac{1}{6}$ what is the Least Common Denominator? What is the meaning of L.C.M.? What will cancel in $\frac{21}{36}$? What fraction is equal to it? What equals $\frac{9}{12}$? How do you find it? Reduce $\frac{18}{36}$ to its lowest terms. What are 10 × 10? 12 × 12? How many sevenths in $3\frac{5}{7}$? How much is $\frac{5}{8}$ from a whole? How many times is 7½d. in £1? Cancel $\frac{26}{39}$. $\frac{99}{12}$ is how many whole ones?

STANDARD VI.

Arithmetic.—Specimen cards.—

A. 1. Find the simple interest on £375 for 292 days at 3¼ per cent.

2. Multiply the sum of 7·5 and ·0175 by the difference between 4·025 and 3·0765.

3. From one yard of cloth 2 ft. 9 in. was cut off; what decimal of a yard was left?

4. I spent ·916 of my money, and then had 13s. 9d. left; what had I at first?

B. 1. Find the simple interest on £750 for $3\frac{3}{4}$ years at $2\frac{2}{3}$ per cent.

2. Find the value of $\dot{7}\dot{2}$ of 3 days 11 hrs. 14 minutes.

3. Five-eighths of a farm is 625 acres. The remainder is divided into two farms. What is the size of each?

4. A room 50 ft. 6 in. long, 12 ft. 10 in. broad, and 10 ft. 9 in. high is to be papered with paper costing 9d. a square yard. What is the total cost?

C. (Girls.) 1. How much tea may be bought for £20 when 3 lbs. 3 ozs. cost 8s. 6d.?

2. Multiply 63·04 by 3·8, and divide the product by ·076.

3. Reduce 1 qr. 17 lbs. 8 ozs. to the decimal of 1 cwt.

4. A, B, and C engage in business, investing money to the extent of £30, £40, and £50 respectively. Their profits amount to £66. What is the share of each?

Answers—*A.* (1) £9 15; (2) 7·261905; (3) ·083; (4) £8 5s.

B. (1) £72 3s. 9d.; (2) 2 days 12 hrs. 32 min.; (3) 187½ acres; (4) £5 13s. 5⅔d.

C. (1) 1 cwt. 1 qr. 10 lbs.; (2) 3,152; (3) ·40625; (4) A's, £16 10s.; B's, £22; C's, £27 10s.

Composition.—Write an account of the Mediterranean, or of the Baltic Sea.

Grammar.—Parse and analyse one of the following sentences:—

A. Such a boat as I could make would never live in their rivers.

B. Of other men whose lives have been written we possess pictures.

STANDARD VII.

Arithmetic.—Specimen cards:—

A. 1. The average attendance at a school in 1880 was 45. In 1881 it was 5 per cent. more, and in 1882 it fell 10 per cent. What was the average attendance in 1882?

2. The population of a town is 276 to 17 acres, 823 to 51 acres, and 893 to 68 acres. What is the average population of the town per acre to two places of decimals?

3. The interest on a certain sum is £2 6s. 9¾d. more at 5¼ per cent. than at 4¾ per cent. What is the sum?

4. If a trough 5 ft. long, 2 ft. broad, and 16 inches deep, holds 50 pails, what is the depth of another trough which is 10 ft. long, 28 in. broad, and holds 625 pails?

B. 1. Find the average of ·004, 1, ·3, and ·03.

2. One sovereign is worth 25 francs. Bring £27 4s. to francs, and also 2112·5 francs to English money.

3. If 8 ponies eat 15 bushels in 6 days, how much will last 20 horses 20 days, if 5 horses eat as much as 8 ponies?

4. What is the greatest number that divides 255, 680, and 595 without a remainder?

Answers—*A.* (1) 42$\frac{2}{11}$; (2) 14·65 nearly; (3) £468 2s. 6d.; (4) 7½ feet.

B. 1. ·3343; (2) 680 francs, and £84 10s.; (3) 200 bushels; (4) 85.

Composition.—Write an essay on your work at school, and how it is likely to help you in your future work.

Grammar.—Parse and analyse one of the following sentences:—

A. Encouraged by the success he had long desired he continued his writing.

B. Are there any flowers that could interest me like these, do you think?

Mental Arithmetic.—For this subject Standards VI. and VII. were examined together, and the following questions were asked:—

What is the simple interest on £500 for four years at 5 per cent.? on £200 for 9 months at 4 per cent.?

720 eggs at 6 for 3d.

What vulgar fraction is equal to ·025?

If a cart and horse cost £60, and the horse cost twice as much as the cart, what was the cost of each?

Divide a shilling between two boys, giving one five times as much as the other.

If $\frac{4}{17}$ of a cake be eaten, what is left?

Take $\frac{1}{5} + \frac{1}{7}$ from 1.

Geography.—For this subject Standards V., VI. and VII. were grouped, the appointed portion of work being the geography of Europe.

Several questions were asked on England and the British Isles; then on the English Channel and Straits of Dover. Name the largest river of France. What towns are on its banks? For what are they noted? Why was Joan of Arc called Maid of Orleans? What became of her? Where was she burned? What is this town remarkable for? What wines are produced? Name the great seaport for exporting wines. What alterations have been made in the map of Europe? On which side of France? Why did not Napoleon III. return to France? What is a Republican Government? Where did Napoleon die? Name the important battle-fields in the Franco-German war. What generals were engaged? Questions were also asked about Blenheim and Waterloo. Where is Bavaria, and what is it noted for? What do you know of the Volga? Why is it a slow river? Name any swift rivers of Europe. Where is the Adour?—the Rhone? Why are they rapid? What do you know of Lake Geneva? Why is its water very blue? Where does the Great Plain of Europe extend? Is the East of England a part of it? What is the character of the East of England? What counties are in that part? Where are the mountains of England chiefly?

—o—

Our Certificate Class.

BY DR. GEORGE BEACH, M.A.

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Head Master of Christ Church Schools, Macclesfield.

GENERAL REMARKS.

1. *Errata.*—On second column of page 221, line 10, read *minus* 21 instead of *plus* 21.

On first column of page 227, sum 4, read *nd* instead of *md.*

2. We are requested to notify to our readers that in the Syllabus for Females the words '*Book I.*,' have been inserted by mistake after 'De Amicitia,' one of the Latin books mentioned.

3. September 30th is the last day for notifying to the Education Department the candidate's wish to sit at Christmas.

4. On page 6 of Form IX. the words 'Christmas Examination' should be written after the name of any teacher who desires permission to sit at Christmas.

5. We have hitherto neglected 'Trench on the Study of Words.' The lectures are so interesting and clear, requiring rather study and appreciation than elucidation, that other and more difficult subjects have the first claims upon our space.

6. Male candidates who are weak in Arithmetic should, in addition to their own exercises, carefully work the questions for Females.

7. As Heligoland, Newfoundland, and our African possessions are just now politically prominent, their geography should be well attended to.

Some short account of Mr. Stanley's recent explorations should be prepared, and the terms of the settlement pending with the Germans respecting Western Africa should be known.

SELECTED GOVERNMENT QUESTION FOR THIRD SATURDAY AND FOURTH MONDAY.

1. Prove that the sum of the squares of any number of unequal quantities is less than the square of their sum.

In an examination it was found that the aggregate marks of each candidate came to the same amount; the examiner then assigned to each the square of the marks originally gained for each subject. Prove that if one candidate, and one only, was totally ignorant of every subject but one, he would come out head of the list. (1889).

2. Solve the equations

(*a*) $x^2 + x + 1 = \frac{42}{x^2 + x}$

(*b*) $\frac{y}{x} + \frac{1}{xy} = 3\frac{9}{20}$, and $xy + \frac{x}{y} = \frac{5}{3}$. (1888).

3. Find the arithmetic, geometric, and harmonic means between a and b.

Given two fractions, show that two new fractions formed by taking as the numerators the arithmetic and geometric means of the original numerators, and taking as denominators the corresponding means of the original denominators are intermediate in value between the original fractions. (1887).

4. Two passengers have together 600 lbs. of luggage, and are charged for the excess above the weight allowed 3s. 4d., and 11s. 8d. respectively. If all the luggage had belonged to one of them he would have been charged £1. How much luggage is allowed free of charge to each passenger? (1886).

5. If $x^3 + ax^2 + bx + 10$ is divisible by $x + 2$, show that $b = 2a + 1$. (1885).

6. Sum the following series $7 + 6\frac{3}{4} + 6\frac{1}{2}$ to 20 terms; and $3 + \sqrt{27} + 9$ to 8 terms. (1885).

7. A train travelling at the rate of 60 miles an hour meets another twice as long, travelling at the rate of 40 miles an hour, and passes it completely in $4\frac{1}{2}$ seconds. Find the length of the first train. (1884).

8. If $ax + by = 1$, then $ab(x^2 + y^2) + xy(a^2 + b^2) + (a - b)(x - y) = 1$. (1884).

SELECTED GOVERNMENT QUESTIONS FOR FOURTH THURSDAY.

Males.

CLIMATE.

1. Show, with illustrations, how climate is affected by—(*a*) Latitude, (*b*) Marine Currents, (*c*) Altitude. What is the mean temperature at the North Pole and Equator respectively? (1889).

2. How is climate affected—(*a*) by distance from the Equator, (*b*) by local influences? Why are the climates in the southern hemisphere distributed with much regularity according to latitudes? (1888).

3. How far are the expressions 'temperate flora,' 'tropical flora' correct; *i.e.*, does identity of latitude with similarity of climate imply agreement in the character of the flora and fauna? Give examples. (1887).

4. How is it that places in the same latitude do not always have the same temperature? Give some examples. (1886).

5. What are the principal causes taken into account by meteorologists in forecasting the weather? (1885).

EXAMINATION IN ENGLISH FOR FOURTH SATURDAY.

Males and *Females.*

1. Paraphrase lines 160—177, Scene 2, Act III.

2. Give briefly such explanation as would be necessary to scholars in the Sixth Standard respecting the meaning and force of the following expressions:—

(*a*) 'to appeal each other of high treason.'
(*b*) 'a caitiff recreant.'
(*c*) 'the eye of heaven.'
(*d*) 'making hither with all due expedience.'
(*e*) 'put on sullen black, incontinent.'
(*f*) 'Julius Cæsar's ill-erected tower.'

3. Sketch briefly the character of Richard II. *or* Bolingbroke.

4. Comment on the two following extracts:—

(*a*) 'And speaking it, he wistly looked on me;
As who should say "I would thou wert the man
That would divorce this terror from my heart;"
Meaning the king at Pomfret.'

(*b*) 'No lord of thine, thou haught insulting man,
Nor no man's lord; I have no name, no title,
No, not that name was given me at the font.'

5. Compare the modern and Elizabethan usage of the following words:—

apparent, defend, depose, cunning, fantastic, nicely, royalties, conceit, attack, native, presently, engage, conduct (noun), pompous.

6. Write out a short essay on *one* of the following:—

(*a*) The good and evil of versifying.
(*b*) The comparative advantages and disadvantages of the study of Mathematics and Classics.
(*c*) 'The best teacher is the least missed.'

7. What do you know of the lives of Tennyson *or* Trench?

SELECTED GOVERNMENT QUESTIONS FOR FIRST AND SECOND FRIDAYS.

Females.

1. How do you know before proceeding to divide whether a vulgar fraction can be expressed as a non-circulating decimal? (1889).

2. By accepting A's offer for land recently purchased I should lose 7 per cent. on the purchase money. By accepting B's offer I should gain 5 per cent. B offers £273 12s. more than A. What did I give for the land? (1888).

3. What is the least number which when divided by 33 leaves 32 remainder, when divided by 37 leaves 36 remainder, and when divided by 43 leaves 42 remainder? Explain the process of working. (1887)

4. Give, with examples, rules for shortening the following processes:—

(*a*) Multiplying by 99 by 25 and by 246.
(*b*) Squaring a number.
(*c*) Finding the interest on money for years and months at $2\frac{1}{2}$ per cent. (1886).

5. A hare pursued by a greyhound had a start of 130 yards. While the hare ran five yards the greyhound ran seven. How far had the hare gone when caught by the dog? (1884).

6. If a wholesale dealer sell beer to a retailer at a profit of 10 per cent., and the retailer sell to the consumer at a profit of 50 per cent., what per cent. of the price paid by consumer is profit? (1884).

7. Compare the incomes derivable from the two investments that follow:—A invests £1,491 15s. in $3\frac{1}{4}$ per cent. at a discount of $12\frac{1}{4}$ per cent. B invests the same sum in $4\frac{3}{4}$ per cent. at a premium of $14\frac{3}{4}$ per cent. (1886).

8. What is meant by present worth? A farmer gave for a horse a bill of £73 due in one month, and parted with him the same day for a bill of £87 due at four months. Find the farmer's gain per cent., the interest being calculated at the rate of $4\frac{1}{2}$ per cent. per annum.

ROUTINE FOR AUGUST (MALES).

DAY	FIRST WEEK				SECOND WEEK				THIRD WEEK				FOURTH WEEK			
MONDAY	Algebra. — Revision	History. — Dates from 1602 to 1714 Stuart Dynasty	School Management. — The vital points of the Code, Articles 3, 11, 12, 13, 15, 82, 83, 89, 90, 92, 94, 104, 106, 111. The various Circulars		Algebra. — Arithmetical Progression	History. — Outlines from 1748 to 1783	School Management. — Notes of a first Lesson on Algebra		Algebra. — Geometrical Progression	History. — Government Questions (See Article)	School Management. — Within what limits can the Teacher influence habits and character?		Algebra. — Government Questions (See Article)	History. — Outlines from 1783 to 1815	School Management. — Headaches. The eyes, pp. 287—310, Carpenter's Hygiene	
TUESDAY	Euclid. — First 199 Deductions of Egan, Part II.	Maps. — Thames and Severn	English. — Paraphrase Lines 144—162, Scene 2, Act III., Richard II.		Euclid. — Revise Book VI. to Prop. 171	Maps. — South Australia	English. — Paraphrase 'We see the Switzers' last will . . . . . upon the majesty of kings' Bacon's Essays, No. XIV.		Euclid. — Deductions 249—251, 261, 266, 268—270 of Egan, Part II.	Maps. — Further India	English. — Paraphrase Lines 930—948 Lancelot and Elaine		Euclid. — Revise first 19 propositions of Book III.	Geography. — The Atmosphere	English. — Paraphrase Lines 32—57, Scene 3, Act III., Richard II.	
WEDNESDAY	Arithmetic. — Proofs of Rules in Vulgar and Decimal Fractions	English. — Write 20 lines of Composition on Lines 152—155 of Scene 2, Act. III., Richard II.	Euclid. — First 17 Propositions of Book VI.		Arithmetic. — Clock Sums	English. — Write 20 Lines of Composition on 'Witchcraft'	Euclid. — Deductions 211, 215—218, 221, 222, 228, 232, 233, 238, 245 of Egan, Part II.		Arithmetic. — Miscellaneous	Algebra. — Learn the proofs of operations and rules	Euclid. — Revise Book II.		Arithmetic. — Equation of Payments	English. — Richard II. to end of Scene 3, Act II.	Euclid. — Deductions, 289, 392, 296, 299, 303, 508, 310, 313 of Egan, Part II.	
THURSDAY	School Management. — The rules of the ordinary Syllogism, Jevon's Logic Primer pp. 53—69	Geography. — Our European Possessions	English. — Questions on matter of Richard II.		School Management. — Spencer on Education. (See Article thereon)	Geography. — Hindostan	English. — Lines 700—958 of Lancelot and Elaine		School Management. — General directions to Pupil Teachers for drawing up Notes of Lessons	Geography. — Australia	English. — Richard II. to end of Scene 1, Act II.		School Management. — Spencer on Education (See Article thereon)	Geography. — Questions on Climate (See Article)	English. — Lines 958—1189 of Lancelot and Elaine	
FRIDAY	Algebra. — Variation	History. — Reign of Elizabeth, pp. 132 to 144, Davies	Writing. — 1 Dictation 2 Copy Book Writing 3 Words or passages previously set		Algebra. — Arithmetical Progression	History. — Literature, pp. 220 to 233, Davies	Arithmetic. — Miscellaneous		Algebra. — Harmonical Progression	History. — Reign of Elizabeth, pp. 144 to 159, Davies	Geography. — Australia		English. — Write 20 lines of Composition upon 'Elizabethan literature'	History. — Revision	English. — Bacon's Essays, 31, 32, 36, 39, and 50	
SATURDAY	Euclid. — Algebraic treatment of ratios and proportion as applied to Geometry	English. — Bacon's Essays, 19, 21, 24 and 25	School Management. — Ventilation (to p. 104 of Carpenter's Hygiene)	Geography. — Motions of the Earth	Euclid. — Revise Book I.	Examination — Euclid (See Article)		School Management. — 1 The Log Book. 2 The Half-Time Register. 3 The Summary Register. 4 The Admission Register.	Euclid. — Deductions 271, 273, 274, 276, 279—282, 285, of Egan, Part II.	English. — Bacon's Essays, 27—30	Geography. — Flora and Fauna of high and extensive ranges of mountains	Algebra. — Government Questions. (See Article)	History. — Lives of Great Men, pp. 187—193, Davies	Examination — English. (See Article)	English. — Lines 1189 to end of Lancelot and Elaine	

ROUTINE FOR AUGUST (FEMALES).

DAY	FIRST WEEK			SECOND WEEK			THIRD WEEK			FOURTH WEEK		
MONDAY	Arithmetic. — Discount	History. — Dates 1624 to 1641. Curtis' Date Book	School Management. — The vital points of the Code Articles 3, 11, 12, 13, 25, 82, 83, 89, 90, 92, 94, 104, 116. The Circulars	Arithmetic. — Fractions	History. — Reign of James I.	School Management. — Notes of a first Lesson on Domestic Economy	Arithmetic — Interest	History. — Commonwealth	School Management. — Within what limits can the Teacher influence Habits and Character?	Arithmetic. — Areas	History. — Reign of James II.	School Management. — Headaches. The Eyes. pp. 287—310, Carpenter's Hygene
TUESDAY	Domestic Economy. — What are the properties of the fibrine, albumen, and gelatine of flesh? How are these affected by salting?	Geography. — Map of Hindostan	English. — Paraphrase Lines 144—162, Scene 2, Act III., Richard II.	Domestic Economy. — What steps would you adopt in urgent cases of croup, nose-bleeding, scalds, burns, dog-bites, and fractures?	Geography. — Map of British Burmah	English. — Paraphrase Lines 72—100, Scene 3, Act III., Richard II.	Domestic Economy. — Describe the different methods of Ironing. To what articles are they applicable? How would you avoid Scorching? When will Mangling suffice?	Geography. — Map of British South Africa	English. — Analyse and Parse difficult words of lines 160—171, Scene 3, Act III., Richard II.	Domestic Economy. — State with accurate items the cost, profit, and benefit to a peasant of a donkey, cow, pig, and poultry	Geography — West Australia and Revision	English. — Paraphrase Lines 32—57, Scene 3, Act III., Richard II.
WEDNESDAY	Arithmetic. — Contracted Square Root	English. — Write 20 Lines of Composition on Lines 152 and 155, Scene 2, Act III., Richard II.	Sewing, etc. — Practise any diagrams wherein you may be deficient	Arithmetic. — Compound Proportion	English. — Write 20 Lines of Composition on 'Witchcraft'	Sewing, etc. — Feather-stitching, herring-boning, knitting	Arithmetic — Insurance	Sewing, etc. — Stocking-web stitch. Swiss-darning a hole. Plain darn on linen	Domestic Economy. — How would you prevent the spread of fever, small-pox, cholera, and Russian influenza?	Arithmetic. — Areas	Sewing, etc. — Cut out and tack together the sleeve of a boy's shirt, and set on wristband	Domestic Economy. — Explain the principles, working, and advantages of Co-operative Stores and Building Societies
THURSDAY	School Management. — The rules of the ordinary 'Syllogism' Jevon's Logic pp. 53—69	Geography. — Australia (Physical)	English. — Notes and text of Richard II. to end of Scene 2, Act II.	School Management. — Spencer on Education. (See Article thereon)	Geography. — Hindostan	English. — Analyse and Parse difficult words of lines 29—32, Scene 4, Act III., Richard II.	School Management. — General directions to Pupil Teachers for compiling Notes of Lessons	Geography. — British North America	English. — Richard II. Remarks of Hazlitt, Coleridge, Gervinus, and Dowden	School Management. — Spencer on Education. (See Article thereon)	Geography. — Revise	English. — Notes and text of Richard II. to end of Scene 2, Act III.
FRIDAY	Arithmetic. — Government Questions. (See Article)	History. — Literature, etc., Davies, pp. 125 to 131, (See Article)	Writing. 1. Dictation. 2. Copy Book. 3. Copy previously set	Arithmetic. — Government Questions. (See Article)	History. — Reign of Charles I.	Sewing, etc. — Any arrears	Arithmetic. — Stocks	History. — Reign of Charles II.	Any backward work	English — Write short lives of— 1. Dryden, 2. Penn, and 3. Clarendon	History. — Dates 1641 to 1649 Curtis' Date Book	Sewing, etc. — Practise 'Plain' Sewing
SATURDAY	Domestic Economy. — State the constituents of peas, lean meat, bread, oatmeal, rice, cheese, and lard	English. — Trench, Lecture II.	School Management. — Ventilation, To p. 104 of Carpenter's Hygiene	Geography — Queensland, N. S. Wales	Sewing, etc. — Practise 'Hedge Tear' and Cross-cut darns	Examination. — Domestic Economy (see Article)	School Management. — The Log Book. The Summary. The Admission Register. The Half-Time Register	Domestic Economy. — In what proportions should an artisan's income be expended in food, clothing, rent, recreation, education, prudence, and benevolence?	English. — French (Revise)	Geography — Victoria, South Australia	Sewing, etc. — 'Plain' Sewing	History, Literature, etc. — Davies, pp. 132 to 138 (see Article)	Examination. — English (see Article)	English. — Trench, One-third of Lecture III.

Answers to, and Hints upon, Questions given in July Number.

ARITHMETIC.

Females.

1. A, 17s. 6d. ; B, £1 ; C, £1 2s. 6d.

2. 2 h. 55 m. p.m.

3. 12 canfuls of each.

4. £500.

5. £275.

6. $15\frac{1}{8}$ ins. square, or $230\frac{1}{64}$ sq. inches.

7. Reduce both the amounts to pence, find the G.C.M. and reduce back to £ s. d. Prove by ordinary method of alternate division. £77 7s. 7d.

9. £3 19s. $8\frac{888}{999}$d. per cent.

10. (3 + 5) : 128 as 1 : 16. ∴ First number = 16 × 3, Second = 16 × 5, Third = 16 × 7, Fourth = 16 × 11. ∴ 48, 80, 112, 176 are the required numbers.

11. 10 per cent.

12. £199 1s. 3d.

13. $100 \times \cdot\dot{3}\dot{6} = 36\,\dot{3}\dot{6}$, $1 \times \cdot\dot{3}\dot{6} = \cdot\dot{3}\dot{6}$, by subtraction $99 \times \cdot\dot{3}\dot{6} = 36$, ∴ $\cdot\dot{3}\dot{6} = \frac{36}{99} = \frac{4}{11}$; ·625.

14. 160 allotments.

15. Half-past twelve.

17. If a be greater than b, then if both a and b are increased by *one*, then the ratio of $(a + 1)$ to $(b + 1)$ is less than the ratio of a to b. *For example*, 5 is greater than 3, then the ratio of 6 to 4 is less than the ratio of 5 to 3, because as 6 : 4 :: 18 : 12, and as 5 : 3 :: 20 : 12, etc.

18 4·995.

19. The field can evidently be divided into two square fields, each containing 40 acres or 6,400 sq poles. By extracting sq. root we get 80 poles as length of shorter side. Then 160 poles = longer side.

20. A diagram to illustrate this question and to assist its solution should be drawn. Inside length = 7 ft. 6 in., inside breadth 2 ft., inside height 2 ft. 9 in. $257\frac{3}{11}$ galls.

ALGEBRA.

Males.

1. $(x - 13)(x + 10)$; $(a - c)(b - a)(c - b)$. This is a good instance of a cyclic expression.

2. $6x + 12x^{\frac{1}{2}} + 24x^{-\frac{1}{2}} + 48x^{-1}$

3. The third part = $\frac{8}{11}$ of the number.

4. All Algebras in treating of ratios show that if $\frac{a}{b} = \frac{c}{d} = \frac{e}{f}$ each of these ratios $= \frac{a + c + e}{b + d + f}$ and also that if $\frac{a}{b} = \frac{c}{d} = \frac{e}{f}$ each of these ratios $= \frac{ma}{mb} = \frac{nc}{nd} = \frac{pe}{pf}$ But similarly if $\frac{ma}{mb} = \frac{nc}{nd} = \frac{pe}{pf}$ these ratios also $= \frac{ma + nc + pe}{mb + nd + pf} = \frac{a}{b} = \frac{c}{d} = \frac{e}{f}$

5. As the x's are = as far as one of the roots is concerned, by subtracting the equations we get that the common root = − 5.

Now in any equation of whatever degree, when one root is obtained, it is evident that the expression will divide by x − the root obtained, *i.e.*, in this case that both the equations will divide by $x + 5$.

Therefore dividing first equation by $x + 5$, we obtain $2x^2 + 11x - 21 = 0$, and dividing second equation by $x + 5$, we obtain $2x^2 - 11x - 21 = 0$.

By ordinary quadratics we then find that the remaining roots are − 7 and $1\frac{1}{2}$: and 7 and − $1\frac{1}{2}$.

6. Another example of a cyclic equation.

7. See any ordinary Algebra.

8. $x = 1$ or − 1.

ARITHMETIC.

Males.

1. $108\frac{1}{2}$.

3. $6\frac{15}{17}$ per cent.

3. 12 o'clock at night.

4. $\frac{88}{1000}$.

5. A cost £$170\frac{10}{13}$; B cost £$145\frac{10}{13}$.

6. £65 12s. 6d.

7. £682 2s. 6d., £735 12s. 6d., £508 5s.

8. 5·1.

SPENCER ON EDUCATION.

(Pages 72 to 113).

Any thoughtful person thoroughly digesting this work must be struck with its mixed characteristics. Amid many recognised wise truisms and original dicta upon education evolved from a broad mind are found daring and unpractical aphorisms, and narrow and prejudiced enunciations. We repeat that very frequently our author fleeing from Scylla falls into Charybdis, and so sarcastic is Nemesis that Mr. Spencer generally condemns elsewhere the excess of which he is now guilty.

As especially wise may be noted—(p. 75) 'We must just systematise the natural process'—(p. 76) 'simply aiding self-evolution'—(p. 77) 'Object lessons . . . . should not cease with early childhood ; but should be so kept up during youth as insensibly to merge into the investigations of the naturalist and the man of science' —(p. 90) 'knowledge is turned into *faculty* as soon as taken in'—(p. 98) lines 15 to 8 from foot—(p. 101) lines 3 to 9—(p. 105) 'parents are ministers and interpreters of nature'—(p. 108) 'that early period at which toys are pulled to pieces in the process of learning their physical properties, and at which the results of carelessness cannot be understood.'

Among the daring unpractical or narrow theorems and remarks we class the following :—(p. 80) In teaching drawing, etc., 'The priority of colour to form should be recognised from the beginning'—(p. 86) 'To bisect a line or erect a perpendicular, to describe a square, to bisect an angle, to draw a line parallel to a given line, to describe a hexagon, are problems which a little patience will enable him to find out for himself'—(p. 89) 'the mental action induced should be throughout intrinsically grateful.'

For positively absurd remarks, note p. 102, 'Did theft give pleasure both to taker and loser, we should not find it in our catalogue of sins. Were it conceivable that kind actions multiplied human sufferings, we should condemn them—should not consider them kind.' Was ever such an inane passage written by so wise a man! No, Mr. Spencer, we cannot conceive such contradictory things.

To prove our assertion that Mr. Spencer condemns his own theorems let our readers compare pp. 79 and 99 with 101. Then, again, why are a child's impulses always good enough to guide us in directing its education, and a parent's impulses in many cases so bad as to deserve reprobation? Yet (on p. 96) it is declared 'We are not among those who believe in Lord Palmerston's dogma that "all children are born good." On the whole the opposite dogma, untenable as it is, seems to us less wide of the truth.'

In connection with p. 80, the student should study the following remarks :—(*a*) In some children the perception of colour is lacking until late, and some remain always colour blind. (*b*) The colour of any object is not an intrinsic or essential attribute like its form, but immediately depends upon external conditions. (*c*) The pleasantest and most desired things are not always the most useful and desirable. Education, even natural, comprises restraint and discipline as well as freedom and development. (*d*) Do children never wish for harmful and attractive things? (*e*) Does Moral Education begin by allowing children to do as they please?

Pp. 86 and 87, in spite of the illustrious support of Professor Tyndall, show what ignorance still obtains among doctrinaires as to the thoughts, desires, and capabilities of the ordinary child. All children are not Spencers and even all teachers are not Tyndalls.

Pp. 91 and 92 seem to show us the long wished for road to learning—the royal road, but we think it is simply the mirage of the author's mind. Lessons cannot always be made pleasurable. Corporeal exercise is not always gratifying. Besides, there are deformities of mind as well as of body which render certain necessary exercises positively painful although their ultimate benefit be great.

Finally we are compelled to remark, as we did last month, that we consider 'Spencer on Education' to be more similar to a target than to a deer or hare. By shooting at the latter we may obtain nourishment, by aiming at the former we simply sharpen our faculties ready for capturing our sustenance elsewhere.

PARAPHRASING.

1. (Lines 144—162, Scene 2, Act III., Richard II.)

I care not where your father may be. I do not wish for cheerful talk, but melancholy conversation. Rather let our down-dropping tears record our grief upon the ground. Ready for our decease, we would with all formality devise our property; but we have none to dispose of, except that we give to the earth the body of a dethroned king.

Now we have lost everything to Bolingbroke, and nought is ours (not even life) but a grave to hide and dissolve the body, *etc.*

2. (Lines 72—100, Scene 3, Act III., Richard II.)

You astonish me. How is it that I have waited so long for the accustomed reverence due to rightful majesty?

If I be king, you are very bold to show me disloyal rudeness.

But if indeed I no longer reign, exhibit to me the Divine warrant that has deposed me.

No mortal or human authority can take my place without incurring the guilt of sacrilege, theft, and arrogance.

3. (Lines 32—57, Scene 3, Act III., Richard II.)

Advance, my noble lords, to the roughly constructed buttresses of that old fortress, and summon by trumpet sound the ruined Richard to a conference.

On my behalf announce that I am come simply to redress my wrongs and to obtain my estates and the rescinding of my exile.

These granted, I will disband my army.

Meanwhile, I respectfully salute the king, and declare myself to be absolutely loyal to him—at present.

But if my unjust treatment be continued, I will employ all my forces to arouse a civil war that shall drench the land with the blood of English dead.

4. Bacon's Essays, No. XIV., '*We see the Switzers' last will.....upon the majesty of kings.*'

The unity of Switzerland continues firm and strong, although the people are divided by religious differences and diverse local and political constitutions.

Their organisation, being for the good of all and not the aggrandisement of a few, endures well.

The United States of Holland are excellently managed, for (as in all countries where men are on the same political level) the deliberations and decisions of the Government are more impartial, and the people pay the taxes with greater good will.

The effect of a powerful aristocracy is twofold, both upon the sovereign and his subjects. To the former it imparts additional splendour, but from him subtracts his despotism. To the latter it lends strength and vigour, but also tends to impoverish them, *etc.*

5. (Lines 930—948, Lancelot and Elaine.)

Lancelot replied, 'If I had intended to marry, I should have done so ere this, my charming Elaine. But now no woman will ever call me husband.'

Elaine answered, 'But without that closer marriage tie, it will satisfy me, if I can be at your side, if I can note your looks, and if I can minister to your needs as a faithful follower.'

'This cannot be,' returned he. 'It would shock conventional propriety. Society is acute enough to discern all that goes on, unfeeling enough to put a shameful meaning thereto, and sufficiently loud and industrious in propagating its malicious rumours. Were I to accede to your request, I should render a poor return for Lavaine's affection and your kind father's hospitality.

PARSING.

1. (Lines 160—171, Scene 3, Act III., Richard II.)

Cousin, well, sighs, revolting, wantons, make, as, thus, still, us, pair, therein digged, would, well, Well, but.

2. (Lines 29—39, Scene 4, Act III., Richard II.)

Go, up, you, like, children, make, stoop, like, executioner, that, too, even, you, employed, root.

3. (Lines 7—15, Scene 3, Act III., Richard II.)

It, beseem, Northumberland, to say, King Richard, alack, day, such, mistakes, brief, out, would, taking, so, whole, length, mistake.

4. (Lines 8—18, Scene 1, Act IV., Richard II.)

Tongue, what, say, arm, as, far, as, very, time, say, that, rather, refuse, than, return, adding, withal, how.

STORY OF LANCELOT AND ELAINE—(*continued.*)

(Lines 523—837.)

When Lancelot had fled away, sore wounded and leaving behind him the diamond, his party informed Arthur thereof. The king immediately commissioned Gawain to find out the unknown knight, to deliver to him the diamond, and then return with news of him.

Then Gawain, all in wrath at leaving the banquet and concourse of knights and kings, got him to horse and went.

Meanwhile the king tarried two days, but learning nothing he returned to the queen who revealed to him the identity of the wounded champion with Lancelot. Arthur in turn told how there were hopes of Lancelot's marriage, for, contrary to his custom, he had worn a lady's 'favour,' in the lists.

In Arthur's presence the queen concealed her jealous anguish at this news, but when alone gave full vent to it.

During this time Gawain had in his search arrived at Astolat, where he told of the unknown knight's success and hurt, and of his own search for him. Being bidden to stay because the knight would return for his left shield, he employed all his courtly art to make Elaine enamoured of him. She, for her part, rebelled against this conduct, showed Gawain the shield and learned who was its owner.

Thereupon Gawain probed her love for Lancelot, left in her charge the diamond, and all wearied of the quest, leapt on his horse and, carolling as he went a true love ballad, lightly rode away to report the measure of his success to Arthur.

He found out that the king had learnt as much as he, but was severely rebuked for leaving the diamond in any hands but Lancelot's.

Going forth from the royal presence he buzzed abroad about the maid of Astolat and her love, till the knights at banquet twice or thrice forgot to drink to 'Lancelot and the Queen,' but pledged 'Lancelot and the lily maid,' maddening thereby the jealous Guinevere. But far away the maid in Astolat obtained permission from her

father to seek Lancelot and to give him the diamond. Then far away, with good Sir Torre for guide, she rode to Camelot and before the city gates came on her brother Lavaine.

Sir Torre then departed up the still rich city to his kin, whilst Lavaine led Elaine across the poplar grove to the cave.

There she first saw Lancelot's helmet with her favour hacked and hewed still upon it, and this sight fed her love. Uttering a little tender dolorous cry at the sight of the knight lying as if he were the skeleton of himself, she gave him the diamond, and declared her intention of nursing him.

Lancelot being perplexed in mind and weak in body did not reply, but sighed and turning aside feigned a sleep until he slept.

HISTORY.

Males.

(1) (Davies pp. 132 to 144.)

Thoroughly master pp. 132 and 133 and draw up a synopsis of Scotch Affairs recorded from p. 133 to line 5 on p. 145.

(2) (Davies pp. 220 to 233)

Omit Harrington, Brooke, Scott, Peel, Daniel, Wotton, Dacres, Middleton, Dekker, Hall, Barnfield, Davison, Marston, Hume, Kyd, Phettle, Golding, and Heywood.

(3) (Davies pp. 144 to 159.)

Draw up an epitome of Irish and Scotch affairs recorded in the pages given.

(4) (Davies pp. 187 to 193)

Omit Audley, and condense the life of Robert Devereux, Earl of Essex.

HISTORY.

Females.

(1) (Davies pp. 125 to 131.)

Omit Beaumont, Vaughan, Chamberlayne, Dillon, Sedley, Heywood, Sheffield, and summarise the account of Dryden.

(2) (Davies pp. 132 to 138.)

Omit Purchas, Camden, Speed, Spelman, Baker, Knolles, Hayward, Calderwood. Wilson, Heylin, and condense the life of Clarendon.

SELECTED GOVERNMENT QUESTIONS FOR THIRD MONDAY.

Males.

1. Describe the relations between England and Scotland under Henry VII. [and Edward VI.] (1889).

2. What was Henry VII.'s claim to the throne? How had the Wars of the Roses tended to strengthen monarchy? What discoveries at home and abroad led to his reign being regarded as the beginning of modern English history? (1887.)

3. Explain the grounds upon which the following persons were put to death:—Sir Thomas More, Lady Jane Grey, Somerset, Mary, Queen of Scots. (1887.)

4. What is understood by Benevolences, Monopolies, the Six Articles, the Suppression of Monasteries? (1886.)

5. Write a short life of Catherine of Arragon. (1885.)

SELECTED GOVERNMENT QUESTIONS FOR SECOND SATURDAY.

1. Construct a triangle whose sides are equal to three given straight lines, any two of which are together greater than the third. Show by diagrams what will happen if you attempt to construct triangles whose sides contain units in the following relations:—(1) 2, 3, 4, (2) 2, 3, 5 (3) 2, 3, 6. (1889.)

2. Describe a square on a given straight line.

From LN, the diagonal of a square LMNR cut off LS, equal to one-fourth of LN and join SM SR. Show that the figure MLRS equals twice the square on LS. (1888.)

3. If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts, together with twice the rectangle contained by these parts. If from one of the equal angles of an isosceles triangle a perpendicular be dropped on the opposite side, the square on that perpendicular is equal to the square on the line intercepted between it and the other equal angle, together with twice the rectangle contained by the segments of the side. (1887.)

4. If a straight line drawn through the centre of a circle bisect a straight line in it which does not pass through the centre, it shall cut it at right angles, and conversely, if it cut it at right angles, it shall bisect it.

PQ, SR, are two equal chords of a circle of which O is the centre. Prove that the line joining O to the point of intersection of these chords bisects the angle between them. (1886.)

5. Draw a straight line from a given point without the circumference to touch a given circle. If two circles touch each other externally the common tangent at the point of contact bisects the two other common tangents. (1885.)

6. The opposite angles of any quadrilateral figure inscribed in a circle are together equal to two right angles.

A circle passes through four points ABCD; under what conditions will the angle ABC be equal to the angle ADC? (1884.)

7. Inscribe a square in a given circle.

If two circles be described one about, and the other within, a right-angled triangle, the sum of their diameters is equal to the sum of the sides of the triangle. (1883.)

8. Describe an isosceles triangle having each of the angles at the base double of the third angle.

Draw (only) the figure required for the construction of a regular polygon inscribed in a given circle. (1882.)

SELECTED GOVERNMENT QUESTIONS FOR SECOND SATURDAY.

Females.

1. Compare the values of beef, mutton, veal, poultry, and fish under the heads of nutrition and economy. (1889.)

2. How are coffee, milk, bread, beer, and butter sometimes adulterated? By what means can such adulteration be most readily detected? (1888.)

3. Give some simple rules for the management of a school savings bank. Should it be permissible to use the bank for the savings of the parents? If not, why not? (1887.)

4. If children are taught in ill-ventilated rooms why should any harm result to them? By what methods and appliances may good ventilation be best secured in a schoolroom? (1886.)

5. What precautions have been taken in this country to prevent the introduction of cholera? Explain them as to a Fourth Standard. (1885.)

6. Describe a kitchen suitable for practical instruction in cookery, including the necessary vessels. What suggestions can you make for disposing of the dishes cooked? (1884.)

7. Draw out Notes of a Lesson to a first class on the principles, working, and advantages of co-operative stores. (1883.)

8. Show the importance, in their bearing upon health, of the water, soil, aspect, drainage, and elevation of our dwellings. (1883.)

CORRESPONDENCE.

1. *We shall be pleased to reply briefly and through this column to any seeking information or advice. Endorse* 'CERTIFICATE EDITOR' *if the office be communicated with.*

2. *Replies demanding urgency will be promptly forwarded per post on receipt of stamped and directed envelope. This privilege does not extend to furnishing solutions and answers to examination questions. A post will be saved by addressing direct to Macclesfield. Upwards of one hundred letters were thus answered during 1889.*

3. *Any suggestions tending to the greater utility and interest of these articles, or to the greater convenience of* 'COACH' *or* PUPIL, *will be thankfully received and thoughtfully considered.*

E. M. (Queensberry), J. L. (East Grinstead), POY (Saffron Walden), G. G. (Aldershot), HUBERT (Ashby), N. (Fleetwood), W. J. (Sunderland), L. O. (Ramsay), E. B. (Borstal), S. S. (Irvine), W. M. (Kettering), STEEN (Church Stretton), B. A. (Queen's-gate), answered per ordinary letter.

ENQ. (Banbridge): It was a mistake, but is corrected in this issue; JUPITER (Leicester): There will be no difficulty about your qualification; it is manifestly impossible in these columns to enumerate all the requisite apparatus; S. P. (Newbury): Kindly read the context carefully, and we believe the apparent contradiction will vanish; 'Z' (Coventry): It begins 'I waited for the train at Coventry:' O. W. (Bishop's Castle): Mr. Spencer is still living.

(To be continued.)

—o—

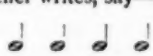
How to Teach School Children to Sing from the Staff Notation.

BY W. G. McNAUGHT,

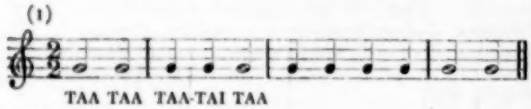
Associate of The Royal Academy of Music.

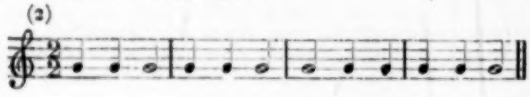
DIVISION II.—THE TEACHING OF TIME—*continued.*

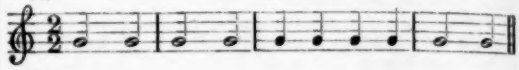
45. The use of the minim as a pulse sign should now be taught. The arithmetical relation of the various signs must be illustrated repeatedly by numerous examples that appeal directly to the minds of the pupils. It is not that musical facts have to be felt, but simply that the meanings of symbols have to be appreciated. Blackboard exercises and demonstrations, in the construction of which the pupils, if not too young, may assist, can therefore usefully precede practice. If the pupils are old enough to be trusted to write on the blackboard, even if only imperfectly, a great impression will be made. Cardboard notes that can be easily suspended or placed in order so as to form a continuous exercise will strongly interest the younger children. In this way the teacher writes, say—

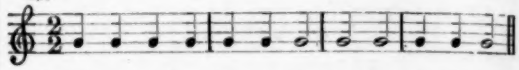


and asks for four notes to be placed below that will show half-values, and then rubs out the four minims and asks for notes double the value of the crotchet. Many exercises can be constructed in this way. When the relative values shown by the symbols are thus made quite familiar the consequence of the adoption of the minim as the pulse sign must be shown. The time names are again useful in this connection because they are so closely associated with musical facts. Children who have been drilled as suggested readily see that if the minim is TAA, two crotchets must be TAA-TAI. The following exercises are specimens of kind required by the Code. The time signatures are given here, but at first they should not be written on the board.

(1)

TAA TAA TAA-TAI TAA

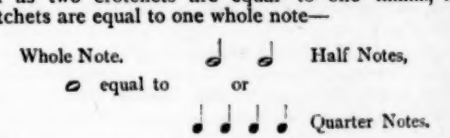
(2)

(3)

(4)

(5)



46. The simplest time signatures may now be introduced and explained to the class. The idea of a figure placed at the beginning of the piece or exercise registering or showing the kind of measure employed, is the first point to establish. Let the pupils decide what figure should be used in a number of two-pulse and four-pulse measures in crotchet time. Then ask them to decide the figure for exercises in minim time. This will suffice for several lessons.

47. The method of indicating by a figure the *kind* of note used as a pulse sign is much more difficult to make plain. For many lesssons it is best to use the expressions Two-minim, Two-crotchet, or Four-crotchet time. In this way the pupils get used to observing the important facts, viz., the kind of measure and the kind of pulse symbol used. When the class is ripe for an explanation of the usual form of time signature the idea that a certain shaped note is theoretically regarded as a WHOLE NOTE, and that other notes show aliquot parts of the whole note, should be introduced. Here, again, the appeal is made not to the ear but simply to the understanding. Blackboard exercises, in the construction of which the pupils assist, are once more the best means of teaching. The points to bring out are that the oval unstemmed note unluckily known as a semibreve, is the whole note; that two minims are equal to one whole note; and as two crotchets are equal to one minim, four crotchets are equal to one whole note—

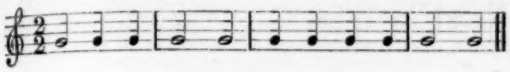


and that owing to these relations of value, minims are often called *Half notes* and crotchets *Quarter notes.* Presuming the children know how fractions are written they will soon see that ½ may mean in music one-half note, and ¼ one-quarter note, and from this it is an easy step to see that ½ means two half-notes in a bar or measure, and ¼ four quarter-notes. Let the time signatures in fact be read as showing fractions of the whole note. Then it will be easy to dwell on the fact that the top figure stands for the number of pulses in the measure and the bottom figure for the kind of note employed as the pulse sign. Care must be taken to ensure that the expressions 'half-note' and 'quarter-note' are not confused with half-pulses and quarter-pulses. As to the absurdity of the postulated whole note being known as a 'semibreve' or half of another note, and the double whole-note being known as a 'breve'—a word that means short—the less said at present the better. Children will not quite understand why twelfth century terms are permitted to burden nineteenth century learners. It is very much to be wished that the words quaver, crotchet, minim, etc., could be entirely banished from musical terminology and that the various notes could be named only in accordance with their relation to the whole-note.

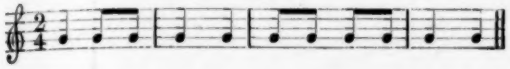
48. A good plan for keeping these relations before the mind of the class is to get pupils to write or dictate the doubling or halving of values of a given series of notes. Thus, ½ time may be transcribed into ¼ time, and ¼ into ⅛ time.

Specimen Exercise in Transcribing Time.

(1)



(2) Half Value.

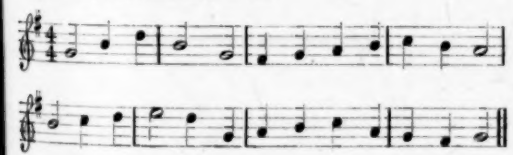


49. Should children in Division II. be taught to beat time? This is a disputed point. It is said that if children beat and sing simultaneously their attention is so distracted that they neither sing nor beat regularly. This, however, need not be if the practice of beating is introduced gradually. At first, pupils should beat only to the teacher's singing, and it is enough if each pulse is registered by light taps on the desk, no attempt being made to show the kind of measure by the direction of the movements. Then the pupils should beat in the same manner to their own performance of exercises in which there are no divisions of the pulse, and afterwards to exercises containing TAA-TAI. Then, introduce the down and up (take care that the down is associated with the strong pulse) of two-pulse measure to the teacher's singing and afterwards to the pupils' singing. The proper beating of three-pulse measure can be introduced six months later, and of four-pulse measure a year or two after that. The advantage derived from the pupils' practice of beating is that they gain a habit of singing regularly, and a habit of observing the connection between the teacher's beating and the music performed. The code does not require children to be able to beat time.

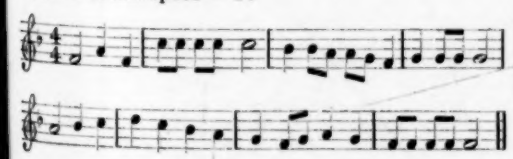
50. The combination of time and tune in one exercise should next engage the attention of the class. This acquirement is not tested in the examination, but nevertheless special studies leading to it must form a part of an educational course. The easiest combination of time and tune is that in which leaps, except from note to note of the *Doh* chord, are excluded, and in which the melody repeats notes or moves smoothly by scale steps. The following are specimen exercises.

Easy Time and Tune Combined.

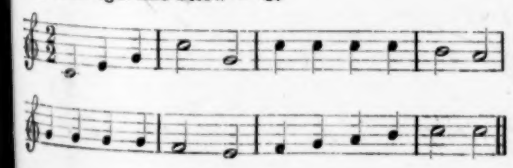
(1) Doh on second line = G.



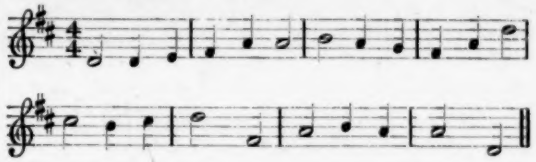
(2) Doh in first space = F.



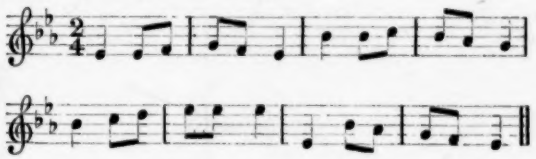
(3) Doh leger line below = C.



(4) Doh in space below = D



(5) Doh on first line = E♭.



(To be continued.)

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Practical Perspective for Pupil Teachers.

BY

E. G. BAKER, B.SC., B.A.,

Vice-Principal of the Training College, Carmarthen.

IV.

VERTICAL LINES.

THUS far we have dealt only with the projection of horizontal lines, but we have demonstrated one principle which applies to the subject now to be dealt with, the projection of vertical lines.

Vertical lines are of course parallel to the picture plane, and hence *the projections of vertical lines will be vertical lines*, for the projection of *any* line parallel to the picture plane is parallel to the line itself.

This fact has already been exemplified in figs. 27 and 28, the vertical edges of the solids there projected having been found to give projections which are vertical lines.

In fig. 27 ABCD is one of the vertical faces of the solid, and the perpendiculars AB, CD, which are the projections of *equal* vertical lines, lie between the lines drawn from E and F to the vanishing point.

The perpendicular distance EF is the *real length*, by scale, of each of the lines AB and CD, and it is important to note that the *real length* is found on a perpendicular rising from the ground line.

Observing this carefully, the student will see that the problem solved in fig. 27 might have been solved without a picture line for the top, as shown in fig. 31. Refer to the problem and re-work as directed.

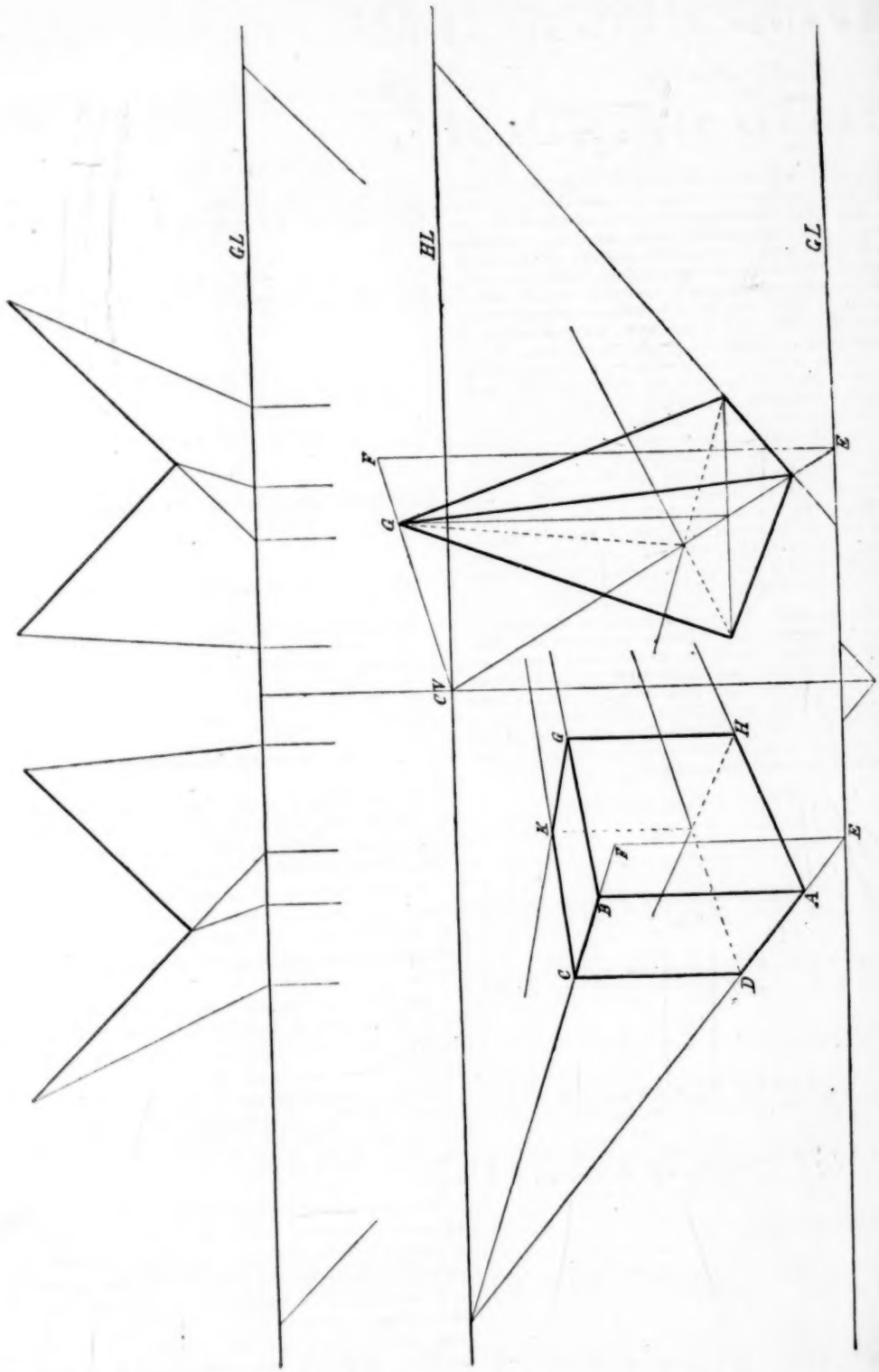

Fig. 31.

DIRECTIONS.—First find the projection of the base in the usual way. Then from E draw EF on the picture plane so that EF is vertical, and equal in length to the height of the solid. Draw from F to the VP on the left. This line is parallel to the line from E, for lines which vanish to the same point are parallel. This line also lies vertically above the line from E. Next draw the perpendiculars AB and DC. These are of the same length (but they are in perspective) as EF. The line BC is the edge of the solid above AD. From B and C draw the edges parallel to AH, *i.e.*, draw lines to the VP on the right. Where these lines meet the perpendiculars from the other two corners of the base, *i.e.*, the points G and K, are the other corners of the solid. If the drawing be correct, the edge GK, when produced, should go to the VP on the left, for that edge of the solid is parallel to AD, and the projections of parallel lines vanish to the same point.

Note carefully that the object was to get the edge standing vertically at A; that to do this a line was taken which passed through A and met the ground line; that where it met the ground line a perpendicular was drawn of the correct height; that from the top of this a line was drawn parallel to the line which passed through A, *i.e.*, to the same vanishing point.

Lines such as EF are called *height lines.*

EXERCISE.—Worked on the right hand side of fig. 31. To be re-worked by the student.

Scale ½ in. to the foot.

A right pyramid, on a square base, stands on the ground plane with the nearest angle of its base 3 ft. to the right of the spectator, and 1 ft. in the picture. The dimensions of the pyramid are, base 3 ft. square, height 6 ft. The spectator is 5 ft. high, and stands 8 ft. away from the picture plane. Two edges of the base recede to the right at 45° with the picture plane.

DIRECTIONS.—First place the base in perspective. Note that the vertex of the pyramid is vertically over the centre of the base. The centre can be found by drawing the diagonals. One of these, if the drawing be accurate, will vanish to the centre of vision, and is convenient for our purpose. Produce it to meet the ground line, and erect the height line 6 ft. high. From its summit draw to the centre of vision. The perpendicular from the centre of the base, to meet the line from F, gives the vertex G. Join G to the corners of the base.

This method of height lines must always be employed to obtain the vertices of such solids as pyramids and cones, and is often very useful on other occasions.

PROBLEMS.

Scale ½ in. to the foot.

In all the following problems the spectator is supposed to be 5 ft. high, and to stand 10 ft. away from the picture plane.

The solids stand on the ground plane.

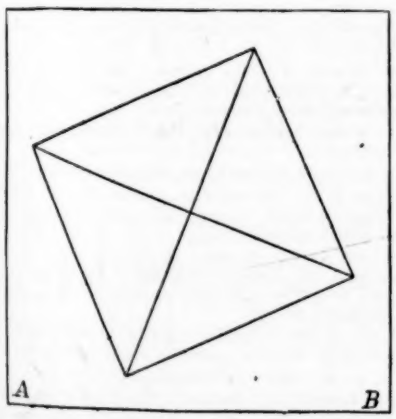

Fig. 32.

Plan of a square slab 1 ft. thick, on which stands a square pyramid 5 ft. high. Point A is 3 ft. to the left and 1 ft. in the picture, and AB vanishes to the right at 30°.

N.B.—The picture line for the base of the pyramid is 1 ft. above the ground line, and it is on the picture line that the height line must be erected for the vertex of the pyramid. The sides of the base of the pyramid have different vanishing points from those used for the slab.

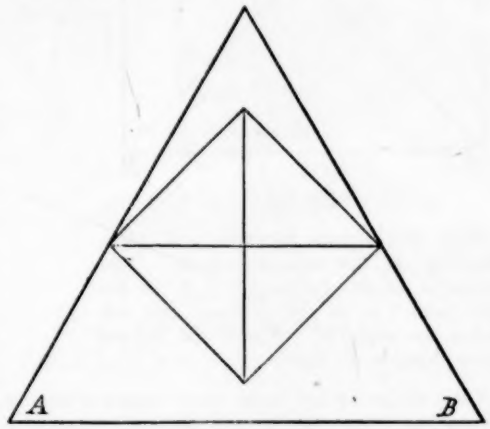

Fig. 33.

Plan of a triangular slab 2 ft. thick, on which stands a square pyramid 4 ft. high.

The edge A is 2 ft. to the right and 1 ft. in the picture, and AB makes an angle of 60° with the picture plane.

Note.—The square had better be obtained by projecting its diagonals.

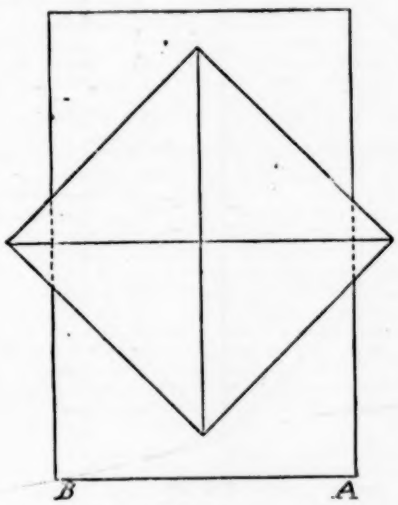

Fig. 34.

Plan of a slab 1 ft. thick, on which stands a square pyramid 5 ft. high. The edge A is to be 2 ft. to the left and 1 ft. in the picture and AB parallel to the picture plane.

N.B.—The picture line for the base of the pyramid and from which its height has to be measured, is 1 ft. above the ground line. The base of the pyramid will overhang the top of the slab. But the method is the same as in the above.

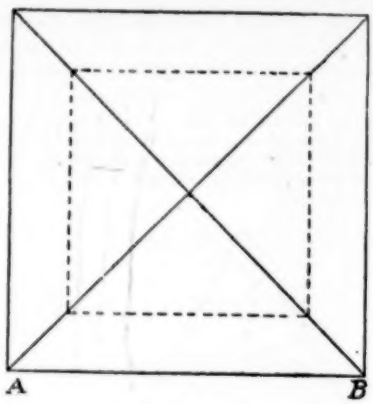

Fig. 35.

Plan of a square pyramid, 4 ft. high, standing on the top of a cube. The corner A of the pyramid is 2 ft. to the right and 1 ft. in the picture, and AB makes an angle of 50° with the picture plane towards the right.

N.B.—The corner A is on the level of the top of the cube.

Draw the picture line for the top of the cube and the pyramid must be projected by means of this line.

The dotted square is the plan of the cube.

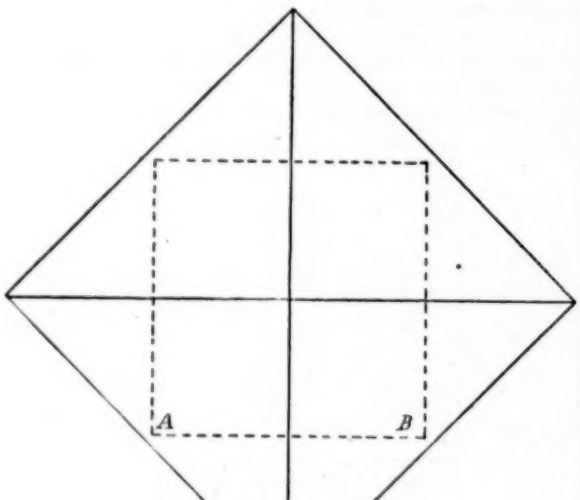

Fig. 36.

Plan of a square pyramid, 5 ft. high, resting on a cube. The point A of the base of the cube is 2 ft. to the left and 1 ft. in the picture, and AB makes an angle of 45° with the picture plane towards the right.

N.B.—It will be found that two sides of the base of the pyramid are parallel to the picture plane.

The centre of vision will be the VP for the other two sides.

Use a picture line for the top of the cube and base of the pyramid, and take the height of the pyramid from it.

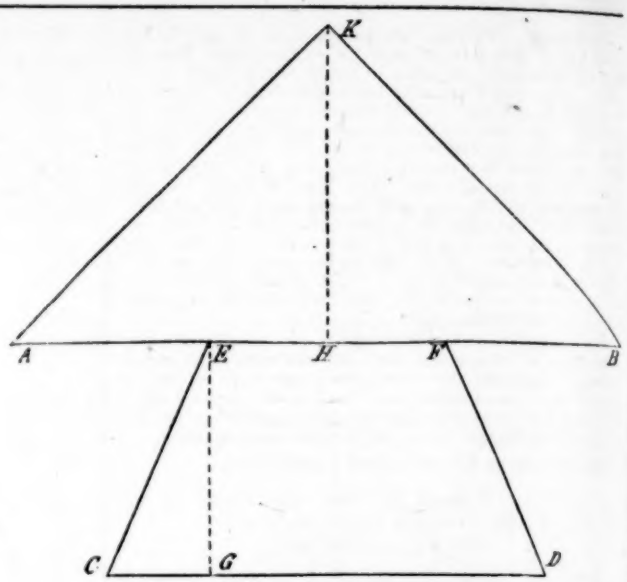

Fig. 37.

Elevation of a frustrum of a square pyramid on which stands another square pyramid. The corner A is 2 ft. to the right and touching the picture plane, and AB vanishes to the right at 45°.

N.B.—The plan will be three concentric squares with sides parallel, and equal to AB, CD and EF.

The squares AB and EF will be projected by means of a picture line at the height EG above the ground line, and KH is the height of the pyramid.

(To be continued.)

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Publications Received.

BELL, G., & SONS.—The Schoolmaster and the Law (*Williams & Markwick*); The Round World—Geographical Reader 812.

BLACKIE & SON.—Elementary Mechanics, Part III. (Elementary Text Books); Blackie's Long Tots.

CHAPMAN & HALL.—Advanced Physiography (*Mills*).

CLIVE, W. B., & Co.—An Elementary Text Book of Heat and Light (*Wallace Stewart*); The London Matric. Directory: June, 1890.

CROSBY, LOCKWOOD & SON.—English History (*White & Dobson*).

CURWEN & SONS.—Shakesperian Songs for Schools (*G. Stokes*).

FISHER UNWIN, T.—The story of the Nations: Scotland (*Dr. J. Mackintosh*); The Century Magazine—Midsummer Holiday Number.

GILBERT & RIVINGTON.—The Lord's Prayer in the Languages of Africa.

GRANT & Co.—The New Code, 1890 (*R. Gowing*).

LONGMANS & Co.—French Passages for Unseen Translations—Higher Course (*Parry*); Elementary Science Lessons, Standard I. (*Hewitt*).

MACMILLAN & Co.—Primer of Bookkeeping (*Thornton*); Merchant of Venice (*Deighton*); Shakespeare's Julius Cæsar (*Deighton*); English men of Action: Lord Clive (*Col. Sir C. Wilson*).

PHILIP, G., & SON.—Philips' Graphic School Atlas: A plea for Slöjd (J. Franzén); Philips' Portable Sun-Dial.

PITMAN, I., & SONS.—Bookkeeping (*D. Tolmie*).

SAMPSON, LOW & Co.—Jackson's New Code Copy books.

WHITTAKER & Co.—The Progressive German Reader (Advanced) (*Lange and Davis*).

Model Answers to Pupil Teacher Examination Papers.

19TH APRIL, 1890.

END OF FOURTH YEAR—*continued.*

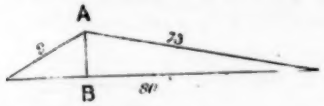
Mensuration.

BOYS ONLY.

(Answer one question only.)

1. The sides of a triangle are 9, 73, 80 feet; find the length of the perpendicular from the greatest angle on the opposite side.

2. Find the expense of making a moat round a circular island at 1s. 3d. per square yard: the diameter of the island being 175 yards, and the breadth of the moat 7 yards 6 inches.



1. $(9 + 73 + 80) \div 2 = 81$.
$81 \times (81 - 9) \times (81 - 73) \times (81 - 80) = 46656$
$\sqrt{46656} = 216$ area of triangle
$216 \div 40 = \underline{5\cdot4 \text{ feet}}$ perpendicular A. B.

2. [Note: This is a sum similar to the one given at the October Exam. The following is the working if the moat is *outside* the island]:—
Radius of island and moat $= 175 + 14\frac{1}{2} \div 2 = 94\frac{3}{4}$
Area $= (94\frac{3}{4})^2 \times \frac{22}{7} = \frac{22}{7} \times \frac{379}{4} \times \frac{379}{4} = 28,165\frac{87}{168}$ yds.
Radius of island $= 175 \div 2 = 87\frac{1}{2}$
Area of island $= (87\frac{1}{2})^2 \times \frac{22}{7} = \frac{175}{2} \times \frac{175}{2} \times \frac{22}{7} = 24,093\frac{1}{14}$ yds.
Diff. (*i.e.*, area of moat) $= 4,071\frac{83}{168}$ yds.
Cost $= 4,071\frac{83}{168} \times 15$d.
$= 61074\frac{1}{168}$
$= 5089\ 6\frac{11}{168}$.
$= \underline{£24\ 9s.\ 6\frac{11}{168}d.}$ Ans.

Arithmetic.

GIRLS ONLY.

(Answer three questions only, including the last, if you can.)

1. Show that the compound interest on a sum of money due two years hence at 6 per cent. per annum will be more than $\frac{3}{25}$ of the sum.

2. Find the discount on a bill for £518 10s. due four years hence at $5\frac{1}{2}$ per cent. per annum.

3. A buys a cow and sells it to B at a gain of 10 per cent., B sells it to C for £12 13s. at a gain of 15 per cent.; what did A pay for the cow?

4. If the interest on a 3 per cent. stock which is bought at 95 is reduced to $2\frac{3}{4}$ per cent., by how much might the value of the stock be expected to fall? Find the loss of income on a sum of £475 invested before the reduction of the interest.

1. The interest for the first year would be $\frac{1}{100}$ or $\frac{1}{20}$ of the principal.

The interest for the second year would be $\frac{1}{100}$ or $\frac{1}{20}$ of the 1st principal + $\frac{1}{20}$ of the first year's interest.

∴ the C. I. would be $(\frac{1}{20} + \frac{1}{400})$ of the 1st principal and $\frac{1}{400}$ of the 1st year's interest. That is, it would be $\frac{1}{200}$ or $\frac{1}{200}$ of the sum invested + $\frac{1}{20}$ of the 1st year's interest.

2. £100 would produce $5\frac{1}{2} \times 4 = £22$

£	£	£	£
122	518½	22	x Discount.

$= \frac{1}{122} \times \frac{1037}{2} \times \frac{22}{1}$
$= 1\frac{407}{122}$
$= \underline{£93\ 10s.}$ Ans.

3. Let 100 = A's buying price,
then 100 + 10 = B's price,
and $110 + \frac{110 \times 15}{100} = 126\frac{1}{2}$ = C's price;
Then £126½ : £12½ : £100 : x. Cost price to A.
$= \frac{253}{2} \times \frac{25}{253} \times \frac{100}{1}$
$= \underline{£10.}$ Ans.

4. 3 : $2\frac{3}{4}$ :: 95 : x value of $2\frac{3}{4}$ % stock
$= \frac{1}{3} \times \frac{11}{4} \times \frac{95}{1}$
$= 87\frac{1}{12}$
The stock would fall $95 - 87\frac{1}{12} = \underline{7\frac{1}{12}}$. Ans.

£	£	£	£
95	475	¼	x

$= \underline{£1\ 5s.}$ Ans.

Penmanship.

BOYS AND GIRLS.

Write in large hand the word *Inconsiderable*, and in small hand, *To walk the studious cloister's pale.*

Geography.

BOYS AND GIRLS.

(Answer three questions only.)

1. Draw a map of—
(*a*) Africa.
or (*b*) Australia.
or (*c*) Hindostan.

2. Describe a voyage from London to Brazil, touching at Lisbon and Saint Vincent.

3. In what parts of the world are the Sikhs, Mongols, Hottentots, Malays, Arabs, and Parsees chiefly to be found?

4. Name the principal exports from the Argentine Republic, the north of Russia, the interior of Africa, and New Zealand.

5. Draw diagrams showing the moon in her third quarter, the position of Venus as an evening star, the positions of the sun and moon for a neap-tide and for an eclipse of the moon. [No description is required.]

(2) A ship loading in the London Docks and bound for Brazil would sail down the Thames past Gravesend and then steer southward round the east of Kent, leaving the Goodwin Sands on the east, through the straits of Dover into the English Channel. Cape la Hague and Ushant might be sighted before the ship steered in a slightly south-westerly direction across the Bay of Biscay. Here rough sailing is often experienced. Cape Finisterre would be the first land of Spain to come into view, and the course having been altered to due south, we should near the mouth of the Tagus, which is well protected. Lisbon, built on an amphitheatre of hills, looks very well from the vessel, but is not very enchanting, on account of dirty narrow streets, ill-kept and unhealthy, upon a nearer acquaintance.

Taking up passengers and mails here we steer south-west, leaving the Madeiras and the Canaries to the east, straight for St. Vincent in the Cape Verde Islands, probably passing through immense quantities of seaweed, to which the islands owe their name. Keeping the same course after about 500 miles we should cross the equator and then near Cape St. Roque in Brazil. If our destination be Rio de Janeiro we should pass the ports of Bahia and Pernambuco, and enter the harbour of Rio after a voyage of 5,500 miles.

(3) The Sikhs are found principally in Northern India; Mongols in the whole of China, but especially in the north of that country; Hottentots in South Africa; Malays in further India and the East Indian Archipelago; Arabs in Arabia, and across the Red Sea in the Soudan of Africa; Parsees in Persia and India, especially in Bombay.

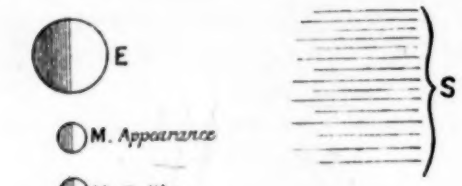
(4) The Argentine Republic exports hides and tallow, cochineal, dyewoods, gums, resin, bark for tanning and medicinal herbs, gold, silver, copper and lead.

From the north of Russia come all kinds of timber, furs and wheat, hemp, flax, tallow, pitch, and tar.

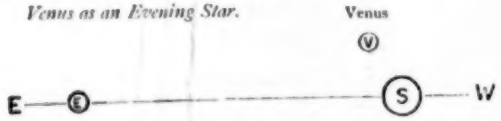
From the interior of Africa we get ivory.

New Zealand sends us wheat, dead meat, wool, tallow, hides, gold and platinum.

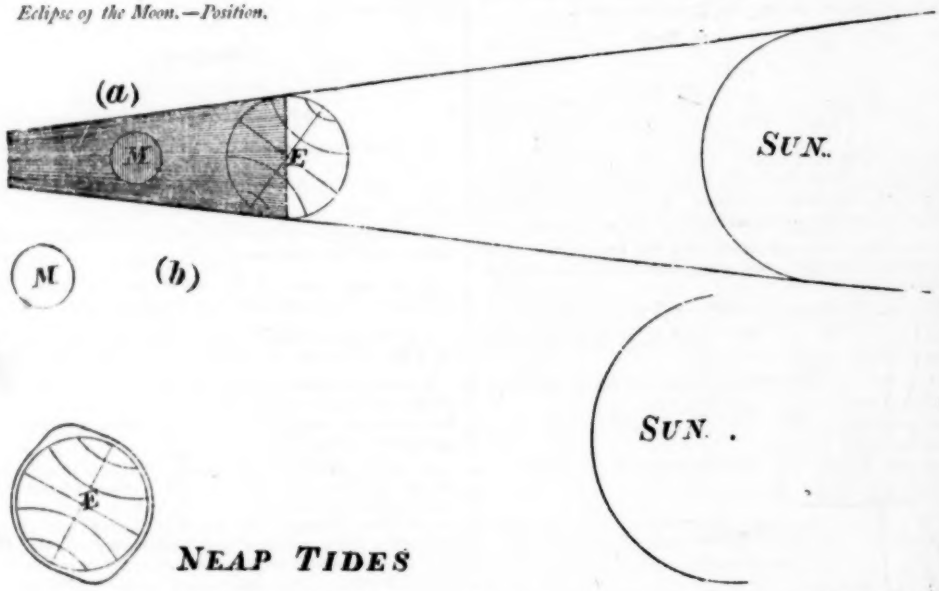
(5) *Moon in Third Quarter:*



Venus as an Evening Star.



Eclipse of the Moon.—Position.



NEAP TIDES

END OF FOURTH YEAR.

(*Two hours and a half allowed.*)

Needlework.

GIRLS ONLY.

(*One hour allowed for this exercise.*)

Darn on coarse linen a three-cornered or hedge tear; the edges of the tear not less than 1 inch in length.

Arithmetic.

BOYS ONLY.

(*Answer three questions only, including the last, if you can.*)

1. An engine while driving machinery burns coal at the rate of $16\frac{1}{2}$ cwt. in $4\frac{1}{2}$ hrs. When the machinery is not in motion, the consumption of coal is only $\frac{4}{11}$ of that rate. How much coal will the engine burn in 396 hours, during $\frac{8}{9}$ of which time the machinery is at rest?

2. What income would be obtained by investing £24,005 4s. 9d. in a 3 per cent. stock at 93? (Neglect brokerage.)

3. Subtract from 4 cwt. the sum of ·625 of 3 cwt. and ·064 of 1 cwt. 3 qrs. 7 lbs. 2 oz.

4. How would you explain to children that $\frac{3}{4}$ of $\frac{4}{5} = \frac{6}{10}$? Simplify $7\frac{9}{11} + 10\frac{1}{15} - 2\frac{7}{33} - 4\frac{9}{10}$.

(1) Working: $\frac{8}{9}$ of 396 hrs. $= 352$ hrs.
At test: $\frac{1}{9}$ of 396 hrs. $= 44$ hrs.

Coal consumed per hour (working) $= \frac{16\frac{1}{2}}{4\frac{1}{2}} = 3\frac{3}{4}$ tons

,, in 352 hours ,, $= 3\frac{3}{4} \times 352$
$= 1320$ tons.

,, per hour (resting) $= \frac{4}{11}$ of $3\frac{3}{4}$
$= 1\frac{4}{11}$ tons

,, in 44 ,, $= 1\frac{4}{11} \times 44$
$= 60$ tons.

Total amount consumed $= 1380$ tons. Ans.

(2) Income $= \frac{£24{,}005\ 4s.\ 9d. \times 3}{93}$
$= \frac{£24{,}005\ 4s.\ 9d.}{31}$
$= £774\ 7s.\ 3d.$ Ans.

(3) ·625 of 3 cwt $= \frac{5}{8} \times 3 = \frac{15}{8} = 1$ cwt. 3 qrs. 14 lbs.
·064 of 1 cwt. 3 qrs. 7 lbs. 2 oz.
$= \frac{64}{1000}$ or $\frac{8}{125}$ of $203\frac{1}{2}$ lbs.

	cwt.	qrs.	lbs.
$1\frac{8}{125} \times \frac{1625}{8} =$			13
4 cwt. $-$	1	3	27
$= 2$ cwt. 0 qrs. 1 lb. Ans.			

(4) I should divide a line of 5 inches into 5 parts, making a clear line at the second division, or $\frac{2}{5}$ of a line. I should then divide the inches into half-inches. In the whole line there would be 10 half-inches. To the second division there would be 4 half-inches, and one half-inch would be $\frac{1}{4}$ of the two inches or of $\frac{2}{5}$ of the line, then 3 half-inches would be $\frac{3}{4}$ of the $\frac{2}{5}$ of the line.

But three half-inches is $\frac{3}{10}$ of the whole line, that is, $\frac{3}{4}$ of $\frac{2}{5}$ of the line is $\frac{3}{10}$ of the line.

This would be a concrete example of the abstract method afterwards to be employed.

Thus: a fourth part of $\frac{1}{5}$ of a thing is $\frac{1}{20}$ of the thing; of $\frac{3}{5}$ of the thing will be $\frac{3}{20}$. Then $\frac{3}{4}$ will be $\frac{9}{20}$. But it takes $\frac{1}{20}$ to make $\frac{1}{10}$. $\therefore \frac{9}{20} = \frac{9}{10}$ that is $\frac{3}{4}$ of $\frac{2}{5} = \frac{9}{10}$.

$7\frac{9}{11} + 10\frac{1}{15} - 2\frac{7}{33} - 4\frac{9}{10}$

Subtract (3) from (1) and (4) from (2).

$= 5\frac{27-7}{33} + 6\frac{28-27}{30}$
$= 5\frac{20}{33} + 6\frac{1}{30}$
$= 11\frac{200+11}{330}$
$= 11\frac{211}{330}$.

History.

BOYS AND GIRLS.

(*Answer three questions only.*)

1. What instances can you give of our alliances (1) with France, and (2) against her? With what objects and with what results were these alliances undertaken?

2. Name some of the great political characters in England during the 18th century? What special distinctions attach to those you have named?

3. Contrast the facilities for commercial intercourse both inland and with foreign countries at the beginning of the 18th century with those in the latter half of the 19th.

4. Sketch the gradual rise and increase of our colonial possessions in America, showing when and how any of them were acquired.

5. Name some of the chief legislative measure of the reign of Victoria, and give a short abstract of the chief points in two of them.

(1.) The *Triple Alliance* between England, Holland and Sweden, leading to the treaty of Aix-la-Chapelle (1668) against France.

The *Grand Alliance* between England, Holland and the empire against France, leading to the war of the Spanish Succession (1701).

The Triple Alliance (1717) between England, France and Holland against Phillip V.

The Quadruple Alliance (1720) between England, France, Holland, and the Emperor, against Spain, Russia and Sweden.

The Quadruple Alliance (1745) between England, Holland, Austria and Saxony, against France and Bavaria.

England, Spain and Portugal were allied against France in the Peninsular War (1809—1812).

England, Brunswick, Hanover and Prussia were allied against France at Waterloo (1815).

England and Turkey were allied with France against Russia in the Crimean War (1854).

(2) Harley and St. John, leaders of the Tory Party in the reign of Queen Anne.

Robert Walpole, noted for financial ability and for his prompt remedy of the South Sea disaster.

William Pitt, Earl of Chatham, who regulated the operations against France with great skill, and who was one of the greatest orators parliament has ever had.

Grenville who extended the Stamp Act to the American colonies, leading eventually to the War of Independence.

Lord North, under whose administration the American War broke out.

Henry Grattan, who succeeded in inducing the Marquis of Rockingham to give legislative independence to Ireland.

William Pitt, who was at the head of the government for upwards of twenty years.

Fox, Burke, and Sheridan, leaders of the Whig party in parliament and usually the great opponents of Pitt.

(3) At the beginning of the 18th century there were neither good roads, railroads, canals, telegraphs, nor telephones. Commerce was carried on chiefly by means of pack horses, or in heavy lumbering waggons, which took much time in going from place to place. The population was only about one fourth what it is to-day, the cotton manufacture was unknown, the coal fields were only partially explored, the iron manufacture was in its infancy, and the great inland manufacturing towns had practically no existence.

To-day the whole country is covered with railways as with a network. In less than twenty-four hours goods of every kind can be sent from one end of the country to the other. Letters and circulars on business can be sent throughout the United Kingdom for a penny or less, instead of costing ten to twenty times as much. The telegraph admits of almost instant communication, while the telephone admits of verbal converse within a range of 50 miles. Roads are good, canals are plentiful, freights are low. A general distribution of labour and productions, and the equalisation of prices, has been the result. What applies to England applies to other countries. Intercourse with them was restricted, ships were only small and slow. Now they are large and swift, and are built of iron and steel instead of wood. The products of other countries instead of being known and enjoyed only by a few are now the everyday pleasures of the many.

(4) (Ans. 4 of third year history would be a suitable answer to this question.)

(5) Repeal of the Corn Laws, 1846; Reform Bills of 1867, 1884, 1885; Irish Land Bills of 1870, 1881; Irish Church Disestablishment Bill of 1869; Education Bills of 1870, 1876; Mines Regulation Bill; Employers' Liability Bill; Merchant Shipping Act; East India Council Bill.

The Reform Bill of 1867 provided for the total or partial disfranchisement of a number of boroughs whose population had decreased, and the increase in the number of members in places whose population had increased. The large counties were divided and representatives given to the separate parts. The franchise was lowered to household suffrage in boroughs, and to forty shillings freehold, and twelve pounds rental in counties.

The Education Act of 1872 imposed upon localities the duty of providing school accommodation for the whole of the children in the localities. Where such provision was not made by voluntary effort, it provided for the establishment of school boards varying in numbers from five to fifteen, according to population. One of its clauses made it a condition of receiving grants that no child should be excluded from the benefits of secular instruction because of a difference in religious belief from the conductors of the school. In Board Schools no distinctive catechism or religious form could be adopted.

Teaching.

BOYS AND GIRLS.

(*Answer two questions only.*)

1. Give notes of a lesson on *one* of these subjects:—

(*a*) Fisheries.
(*b*) The possessive case.
(*c*) Multiplication by factors.
(*d*) *For Infants.* The five senses.

2. Name some pieces of poetry which you think most suitable either (*a*) for the elder children in an infant school, or (*b*) for scholars of the Sixth Standard.

3. Show how you would teach the forms and proportions of the capital letters; and describe the ruling and arrangement of those copy-books which you have found most helpful in the teaching of writing.

4. Mention some of the commonest mistakes in the speech of the children of your own neighbourhood, and say how you think such mistakes may be corrected.

(1) (*b*) *The Possessive Case.*

[Lessons on the nominative and objective case will have preceded this lesson. Question on these and then proceed.]

'There is another relationship in which nouns may be placed besides being the subject or object of a verb. A noun may be so placed as to denote ownership or possession. When this happens the noun undergoes a change, and is said to be in the *possessive case.*'

Example [Write on blackboard]: John hat, Mary bonnet. This looks as if a person were called John hat or Mary bonnet. Ask what is meant. Answer—John's hat, &c.

To show this we put 's? Why not s only? Show s only is the sign of plural number. To mark difference (and for other reasons) apostrophe is placed before the s. Write the two examples given correctly and give singular nouns in great numbers for other examples.

Next write—Boys books. Girls work. What number is boys? Girls? There is nothing here to show that the boys and girls own the books and work. If we put 's as in the first example we should have the unpleasant sound of boys's books. To avoid this we put the ' only, and get boys' books, girls' work.

Rule (deduced from example): The possessive case singular is formed by adding 's to the nominative. If the plural ends in s the possessive case is formed by adding the ' only.

Give number of examples orally, then have some written in both numbers.

Exceptions: Next deal with exceptions in singular, as conscience, justice, &c., and with plurals as men, children.

(2) *Sixth Standard Pieces*:

Selections from Julius Cæsar, Richard II., King John, Coriolanus from Shakespeare.

Selections from Paradise Lost (Milton), Lady of the Lake, or any other poem of Scott, Waterloo (Byron), Horatius (Macaulay), Elegy in a Country Churchyard (Gray), Task and Mother's Picture (Cowper), Part of Excursion (Wordsworth).

(3) Arrange the letters in groups according to the method of their formation, beginning with the least complex letters. Analyse the letters and, by copy on the black board to be imitated on the slate, show the kind of curve and the strokes of which the letters are composed. Then rule the blackboard according to Mulhauser's system (which is the most perfect system of ruling) namely, seven parallel lines with diagonal lines across the three inner lines sloping at an angle of 60°. Where necessary the diagonals can be extended to top and bottom.

(4) [This question admits of so many varied answers that no general answer can be given. In answering it, the following points should be attended to: the use of one vowel sound for another, the omission of parts of words, the misuse or non-use of the aspirate, the sound of the letter r, and the agreement between subject and predicate. These will include most of the peculiarities of dialect.]

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Short Studies in English Literature.

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IV.

MILTON'S LYCIDAS.

THE famous monody, *Lycidas*, is, in some respects, the most important, as it is the latest of the poems written by Milton in his earlier poetical period. In beginning to study it the student should carefully read and re-read it with a view to getting such grasp of its meaning and spirit as is possible without the aid of notes and explanations. To understand it fully, however, he is sure to find it necessary not only to seek out the meaning of many words, phrases, and allusions, but also to make himself acquainted with the circumstances which prompted its production, and with the character of contemporary events, particularly as they affected the life and opinions of the poet.

'One of the most characteristic traits of Milton's genius, until he laid hand to *Paradise Lost*,' remarks Dr. Garnett, 'is the dependence of his activity on promptings from without.' After writing *Comus* in 1634, he appears to have refrained from poetical composition for three years, although as he said in a letter to his friend, Charles Diodati, in the summer of 1637, 'You make many inquiries as to what I am about; what am I thinking of? Why, with God's help, of immortality! Forgive the word, I only whisper it in your ear! Yes, I am pluming my wings for a flight.' It is hardly likely that *Lycidas* is here intended. More probably the expression refers generally to Milton's intention to write some poem 'which the world would not willingly let die.'

The special event which called forth *Lycidas* was the drowning of Edward King, son of Sir John King, Secretary for Ireland. Admitted to Christ's College, Cambridge, in 1626, he was a fellow student of Milton's, and in 1630 he was made a Fellow of his College. In 1633 he took the degree of M.A., and remained at the University with the intention of taking orders. In August, 1637, he sailed from Chester for Dublin, to visit his friends in Ireland. The ship struck on a rock on the Welsh coast near Anglesea, and King was drowned, very few of those on board escaping from the wreck. It is said that he clasped his hands in prayer on deck, and made no struggle to save himself. Edward King appears to have been a student of distinction, who had written some poetry, and made for himself many friends at Cambridge. His death was generally mourned, and a collection of thirty-six elegies by his university friends was published in November, 1637. The last of these was *Lycidas*, first published with the initials J. M.

The author calls the poem a monody, that is an ode in which a single mourner pays a tribute to the memory of a lost friend. Its form is that of a pastoral elegy, in which the poet appears in the character of a shepherd lamenting the death of a brother shepherd. The diction, however, has a sustained dignity which gives it the stamp of an ode, while its metrical structure has much greater variety than belongs to ordinary elegiac stanzas.

The prevailing character of the verse, it should be observed, is rhymed iambic pentameters, interspersed with trimeters, and with the rhymes occurring in irregular order. The first fourteen lines, it has been noted, form a sonnet departing considerably from the normal form; there is no adjacent line rhyming to the first line, and the fourth line is curtailed to a trimeter. The last eight lines of the poem form a stanza in *ottava rima*. There are several lines in the poem without rhymes, namely, 15, 22, 39, 51, 82, 91, 92, 161. Some of the rhymes are imperfect, for example 'excuse' and 'muse' (ll. 18, 19); 'appeared,' 'heard' (ll. 25, 27); 'gone,' 'o'ergrown' (ll. 37, 40); 'return,' 'mourn' (ll. 38, 41); 'flood,' 'mood' (ll. 85, 87); 'feast,' 'guest' (ll. 117, 118); 'jessamine,' 'woodbine' (ll. 143, 6); 'wears,' 'tears' (ll. 148, 150). Most of these defective rhymes are of the kind commonly allowed in English poetry, and regarded as excusable on the ground of the comparative poverty of the English language in rhyming forms.

It is not possible, however, to read *Lycidas* aloud and attentively without noticing the music and the resonance of its verse, nor without observing also the remarkable fitness of the sound to the sense expressed. Witness the sweetness of such lines as—

> 'With wild thyme and the gadding vine o'ergrown,'
> 'Fanning their joyous leaves to thy soft lays,'

and the passage beginning—

> 'Ye valleys low, where the mild whispers use.'

Witness the dignity and firmness of the lines descriptive of fame, 'That last infirmity of noble mind.' Witness, too, the artistic harshness of the passage which describes the unfaithful shepherds, especially in such lines as—

> 'Grate on their scrannel pipes of wretched straw.'

It is this choice of the most fitting words which forms the true explanation of the use of many words which Dr. Johnson needlessly resented as coarse and vulgar, as 'scramble at the shearer's feast,' 'shove away the worthy bidden guest.'

While we fail not to note the force, vigour, and harshness of Milton's diction in some parts of his poem, neither should we fail to recognise what Dr. Garnett speaks of as 'the dainty trills and tremors of subtle versification, and the witcheries of verbal magic in which *Lycidas* is so rich:—"the opening eyelids of the morn;" "smooth-gliding Mincius, crowned with vocal reeds;" Camus's garment, "inwrought with figures dim;" "the great vision of the guarded mount;" "the tender stops of various quills;" "with eager thought warbling his Doric lay."'

It may be well now to help the student in compiling a list of the words specially noticeable as archaic, or otherwise peculiar. In these the poem abounds.

Sere (l. 2), dry, withered, is allied to the verb *to sear*, to burn up.

Crude (l. 3), raw, unripe, unprepared, from L. *crudelis*, whence cruel.

Shatter (l. 5), scatter; these words are doublets and cognate.

Mellowing (l. 5), ripening, used actively for making ripe or mellow.

Dear (l. 6). This word at first meant precious, costly; then it came to mean loved; but it was used by Shakespeare as expressing intimate personal relation, or intense feeling even though quite different from the emotion of love. Examples: 'My *dearest* foe,' 'Hated his father *dearly*.'

Prime (l. 8), 'time of vigorous life.' King was only 25 years old when he was drowned. Latin *primus*, first, used in sense of best.

Peer (l. 9), equal, from Lat. *par*.

Rhyme (l. 11), verse. The old spelling used by Milton was *rime*, from A.-S. *rim*, number. The *h* has been inserted through confusion of the word with *rhythm* from Gr. *rhythmos*, measured motion, metre.

Welter (l. 13), roll about, connected with German *walzen*, whence waltz; also allied to *wallow*.

Meed (l. 14), reward, recompence, allied to Greek *misthos*.

Coy (l. 18), hesitating; lit. quiet, from Lat. *quietus*, through Fr. *coite*, used in sense of shy.

Urn (l. 20), grave, tomb. The word refers to the Roman practice of preserving the ashes of the dead in an urn. Compare 'storied urn' in Gray's *Elegy*. 'Destined urn,' means the tomb in which I shall be laid.

'*Sable shroud*' (l. 22), dark grave-clothes; this may also be figurative for tomb.

Afield (l. 27), on field, an adverb for, to the field, or in the field.

Gray-fly (l. 28), possibly the gnat, possibly the trumpet fly, which makes a sharp humming noise in the hot part of the day.

Battening (l. 29), feeding, from the same root as *batter*; *battels* for college rations is also from the same. The verb is generally used intransitively as in Hamlet: here it is transitive.

Westering (l. 31), passing towards the west—an obsolete word.

Wheel (l. 31), course or orbit.

Ditties (l. 32), songs intended to be sung; originally *ditty* meant the words of a song; from Lat. *dictatum*, something dictated.

Tempered (l. 33), modulated, attuned, from Lat. *temperare*, to regulate.

Oaten flute (l. 33), pipe made of reeds, a shepherd's pipe, commonly made of the straw of oats.

Gadding (l. 40) straggling. The verb *gad* means to wander about idly; *gaddest* occurs in Jeremiah, ch. 2.

Copses (l. 42), woods of young or small trees; *copse* is contracted from *coppice*, from Fr. *couper* to cut.

Canker (l. 45), canker-worm, a kind of caterpillar that eats rosebuds. Akin to *cancer*.

Taint-worm (l. 46). This may mean any kind of worm or insect causing taint or disease in sheep, or it may be the *taint*, a small red spider, which was believed to attack and injure cattle and horses.

Weanling (l. 46), applied to young animals just deprived of their mother's milk; *wean* is a verb meaning to accustom to originally, but later limited to accustom to do without; *ling* is a diminutive ending. The forms *yean*, *yeanling*, and *eanling*, also occur.

Wardrobe (l. 47), properly means a place where clothes are kept, from Fr. *garde robe*, also applied to the clothes contained.

Whitethorn (l. 48), hawthorn or may-blossom.

Steep (l. 52), a mountain on or near the Welsh coast, possibly Penmaenmawr.

Shaggy (l. 54) in allusion to the woods which formerly crowned the heights of Anglesea.

Wizard (l. 55), used for magical; the Dee was reputed to be a haunted stream exercising a mysterious influence on the fortunes of the lands it passed through.

Ay me (l. 56), for *ah me!* an exclamation of sorrow, from Fr. *aymi*.

Rout (l. 61), a disorderly rabble, from Lat. *rumpo*, I break; *ruptus*, broken. *Rout*, a defeat, is the breaking up of an army.

Boots (l. 64), profits, from A.-S. *bot* = profit, whence *bootless*, akin to *better*.

Strictly (l. 66), carefully, devotedly.

Meditate (l. 66) practise, apply one's self to (the task of writing poetry).

Use (l. 67), are accustomed to do. We still have the word *used* employed in this way in the past tense, but the present is no longer thus employed.

Tangles (l. 69), locks, curls, tresses.

Guerdon (l. 73), reward; the first part of the word is said to be from an old High German word meaning *back*, and the second from Lat. *donum*, a gift. It is also said to be corrupted from old German *widarton*.

Thin-spun (l. 76), fragile, like a fine thread, hence of uncertain duration.

Glistering (l. 79), shining, allied to *glisten*, *gleam*, *glint*, *glitter*, *glow*.

Foil (l. 79), a thin plate of shining metal used to set off a gem, from Lat. *folium*, a leaf.

Felon (l. 91), cruel, treacherous; this word is usually an adjective; it is possibly connected with *fell*, fierce.

Beakèd (l. 94), pointed, from beak of a bird.

Level brine (l. 98), calm sea; *brine*, means salt water.

Perfidious (l. 100), faithless, treacherous, from Lat. *per*, away, *fides*, faith.

Rigged (l. 101), provided with sails and ropes.

Reverend sire (l. 103), applied to the University of Cambridge in recognition of its antiquity and the respect due to it. *Sire* is derived from Lat. *senior*, elder. *Sir*, *signor*, *seignor* are other forms of the same word.

Footing (l. 103), walking.

Bonnet (l. 104), a man's cap, compare Scotch *bonnet*.

Inwrought (l. 105), embroidered, worked in.

Sanguine flower, the hyacinth, fabled in Greek mythology to have sprung from the blood of Hyacinthus, the petals bearing marks interpreted as Ai, Greek for *alas*.

Reft (l. 107) participle of old verb *reave*, to rob. *Bereave* is from this root, compare *reivers*, cattle lifters of the borders.

Quoth (l. 107), past tense of verb, used for present or past, the present form being obsolete except in the compound, *bequeath*.

Pledge (l. 107), child, pledge or token of the parent's love.

Massy (l. 110), massive.

Twain (l. 110), archaic form for *two*.

Opes (l. 111), opens. *Amain*, firmly, from A.-S. *maegan*; *might*, strength.

Stern bespake (l. 112), said sternly; here, *bespake* is used intransitively.

Enow (l. 114), enough, an old form still used as a provincialism.

Recks (l. 122), cares, used impersonally; for 'what do they care?'

Sped (l. 122), provided for, an uncommon use o the word.

List (l. 123), choose. This word is often used impersonally; it is derived from A.-S. *lust*, pleasure.

Flashy (l. 123), worthless, but showy. Lord Bacon, in his essay on studies, uses this word in the same sense, 'flashy things.' It is derived from *flash*, a transient gleam of light.

Scrannel (l. 124), used in Lancashire as a provincial word for *lean*, *meagre*.

Draw (l. 126), inhale with their breath.

Privy (l. 128), private, secret, stealthy.

Two-handed engine (l. 130), instrument of punishment. Some consider that this refers to the two Houses of Parliament; others, that it was the axe, wielded by two hands, with which Laud was executed; others again, the sword of the Scripture—the two-edged sword of God's word—the Old and New Testaments—the civil and ecclesiastical power.

Flowerets (l. 135), diminutive from flower.

Use (l. 136), dwell, inhabit, an obsolete use of this word.

Swart (l. 138), black or dark, causing blackness by means of heat. Other forms of the word are, *swarth*, *swarthy*, *swarty*. The 'swart star' is Sirius, the dog-star.

Quaint enamelled (l. 139), fanciful and painted as on enamel. The idea of brightness is included in enamelled, and possibly variety of colour.

Honeyed (l. 140), sweet, refreshing.

Rathe (l. 142), early. An obsolete word, positive from which *rather* is formed.

Forsaken (l. 142). Milton first wrote '*unwedded*,' and Shakespeare has 'Pale primroses that die unmarried.'

Freakt with jet (l. 144), spotted with black. *Freckle* is from the same root as *freak*.

Wan (l. 147), pale, faint.

Daffadillies (l. 150), daffodils. The daffodil is the same as *asphodel*, the former being corrupted from the latter. Greek *asphodelos*, a kind of lily, hence old Fr. *asphodile*, old Eng. *affodile*, later Eng. *daffodil*, and *daffadown-dilly* used by Spenser.

Laureate hearse (l. 151), tomb decked with laurels, as symbolic of poetry or learning. Hearse, derived from *harrow*, was formerly a framework for holding candles to light over a tomb in a church, then the coffin, later a carriage for the corpse, and sometimes for the tomb as here.

Dally (l. 153), trifle.

Monstrous (l. 158), full of monsters.

Hold (l. 162), castle.

Ruth (l. 163), pity, whence *ruthless*. The root is the verb *rue*, to be sorry for.

Anon (l. 169), in one instant, immediately.

Tricks (l. 170), decks, adorns, dresses.

New spangled ore (l. 170), sparkling metal.

Nectar (l. 175), the wine of the gods. *Oozy*, slimy, from *ooze* noun, slime, mud; to ooze, to flow slowly.

Unexpressive nuptial song (l. 176), inexpressible marriage song. For this usage compare 'the inexpressive she' in '*As you like it*.' *Nuptial* is from Lat. *nubere*, to marry.

Genius (l. 183), guardian spirit.

Uncouth swain (l. 186), rude, uncultivated peasant, shepherd. The swain is Milton himself.

Stops of various quills (l. 188), small holes of different reeds. The idea is that the poet has touched his subject in various moods and different forms of verse.

Doric lay (l. 189), pastoral poem, in allusion to the Doric dialect used by the principal writers of Greek pastorals.

Twitched (l. 192), pulled about him closely.

The student should notice the following special points in grammatical construction:—

Line 6. *Compels*, a singular verb has two nominatives, which may be regarded as forming a compound idea.

Lines 10, 11. 'He knew to sing,' is in imitation of a Latin idiom, as also is the expression 'build the lofty rhyme.'

Line 28. *What time*, etc., is another Latin idiom equivalent to 'at the time when,' etc.

Line 57. This line affords an example of an *anatoluthon*, a sentence broken off, unfinished, being interrupted by a fresh thought. The break is intentional.

Line 76. An example of *zeugma*, 'slits' governs 'praise' as well as 'life,' but the sense is not quite the same in each case. The Fury cuts the thread of life, but does not prevent the praise.

Line 80. The verb *lies* should be parsed as following 'nor' in the previous line.

Line 102. *Sunk* in modern English would be *sank*.

Line 104. *Mantle* and *bonnet* are instances of the nominative absolute.

Line 129. *Nothing said*, is another absolute construction.

Lines 154-5. 'The shores and seas wash thee far away' is an example of *zeugma*. The seas wash, and the shores throw back, the body.

Lines 166. *Your sorrow*, means the object of your sorrow.

Line 174. *Along*, a preposition governs the two nouns which precede it.

Line 184. *In thy large recompense*, as a great reward for thee.

We have, perhaps, dwelt at sufficient length for our purpose on verbal and grammatical considerations, enough certainly to emphasise the student's conviction of the wealth and variety which mark Milton's poetical vocabulary. His language in this poem is no less remarkable for its richness in epithets and metaphors. To help in the formation of a just idea of the former, we would suggest the selection of all the epithets with the nouns attached, and a classification of the examples according to the various arrangements adopted. Here are some examples of the variety of order:—'Myrtles *brown*,' 'berries *harsh* and *crude*,' '*sad* occasion *dear*,' '*watery* bier,' 'denial *vain* and *coy* excuse,' '*fresh* fields and pastures *new*.'

The use of metaphors and other figures of speech is even more striking as a feature of the work. The whole poem, it may be observed, is figurative, for the basis of it is the comparison of scholars and poets to shepherds—the work of the student and author to 'the homely slighted shepherd's trade.' Mingled with the ordinary elements of pastoral poetry, we have an almost excessive introduction of classical allusions, which are in themselves for the most part highly involved metaphors. In illustration of this note the invocation to the muses,—'sisters of the sacred well,' the spring of Helicon; the reference to the education of the two friends at Cambridge, as being 'nurst upon the self-same hill;' their community of employment in study, as feeding 'the same flock,' driving them afield 'under the opening eyelids of the morn,' till the setting of the stars at night; their tuning 'rural ditties' on 'the oaten flute' to the dancing of satyrs and fauns and the approval of Damætas. The satyrs and fauns are sometimes supposed to mean the less intelligent, pleasure-loving students, and Damætas has been variously identified with Mr. W. Chappell or some other college tutor.

Again the appeal to the nymphs, the guardian spirits of the sea, introduces allusions to 'the steep,' probably of Penmaenmawr, to the mountains of Mona—Anglesea, and to the Deva or Dee; and then to Orpheus, son of Calliope, and his dreadful death at the hands of the Thracian Bacchantes, and again to Amaryllis and Neaera, names of imaginary shepherdesses, from the Greek pastoral writers, and used by Milton to symbolise enticements to the abandonment of duty for pleasure.

In the passage of 'higher mood' in which fame or the love of fame is described, there are allusions to the Fury, or rather the Fate, Atropos, to Phœbus and to Jupiter. The poet then takes up again his purely pastoral strain, invoking the fountain of Arethusa in Sicily, suggestive of Theocritus, and the Sicilian muse, and the Mincius, a tributary of the Po, associated with Virgil. Here are references to Triton, 'the herald of the sea;' to Neptune, the sea god; to Hippotades, that is Æolus, son of Hippotes, and ruler of the winds; to Panope and her sister Nereids, daughters of Nereus, nymphs of the Mediterranean.

The next section referring to Camus (Cambridge) is highly figurative, and includes one of the most remarkable and characteristic passages in Milton's early writings. The introduction of 'the pilot of the Galilean lake,' that is Peter bearing the keys, symbolising his power in heaven and hell, has been severely criticised as highly incongruous, especially by Dr. Johnson, who not only depreciates the strictly pastoral parts of the poem but goes on to say it 'has yet a grosser fault. With these trifling fictions are mingled the most awful and sacred truths, such as ought never to be polluted with such irreverend combinations. The shepherd likewise is now a feeder of sheep and afterwards an ecclesiastical pastor, a superintendent of a Christian flock. Such equivocations are always unskilful; but here they are indecent, and at least approach to impiety, of which, however, I believe the author not to have been conscious.' Johnson seems indeed, to have been utterly unable to understand the lofty, earnest character of Milton's lines; political and religious prejudice appear to have blinded him to their merits. As an antidote to his severe censure the student should, if possible, read Ruskin's lecture on 'Queen's Gardens,' in *Sesame and Lilies*, where the writer evinces his strong sympathy with the forcible utterances of Milton by analysing the language and demonstrating its extreme fitness for the purpose the poet had in view—a purpose indicated in the words of the argument prefixed to the edition of the poem published in 1645:—'The author . . . by occasion, foretells the ruin of our corrupted clergy, then in their height.' Ruskin notes how Milton's indignation was rightly poured out upon those hireling shepherds who for the sake of gain—'for their bellies' sake—creep, and intrude, and climb into the fold.' He shows how these three verbs fitly describe the ways in which self-seeking pastors make their way into the Church, by creeping hypocrisy, by arrogant intrusion, or by ambitious climbing. The powerful metaphor, 'blind mouths,' which has been criticised as particularly incongruous and confused, or briefly explained as meaning 'blind gluttons,' Ruskin contends is strikingly appropriate and forcible because it condenses so perfectly into a brief expression the opposites of the two characteristics most proper to true shepherds. As *bishops*, that is overseers, their special faculty should be that of *seeing*, as *pastors*, their special duty is *feeding* the sheep. The false shepherds instead of seeing are *blind*, instead of feeding they are mere *mouths* for eating. The thoughtful student will be able to trace out the references to the selfish careless-

ness of the corrupt clergy for anything but their share of the endowments of the church, to their neglect of their congregations, their false teaching, and its corrupting results, and to the stealthy progress of the power of the Romish church—'the grim wolf with privy paw.' The frequency with which our Lord refers to ministers as shepherds, and to false teachers as wolves in sheep's clothing, forms sufficient justification of the metaphors employed by Milton.

In the events of the time, the Romish tendencies of Laud, the doings of the court of High Commission, Milton would, from his standpoint, find ample justification for the sternness of his denunciation. It is here that it becomes so necessary, in order to understand the poetry, to be well acquainted with contemporary history, and the poet's position with regard to it. Of the passage we have just considered, Mr. Pattison says it 'raises in us a thrill of awe-struck expectation which I can only compare with that excited by the Cassandra of Æschylus's *Agamemnon*. For the reader to feel this, he must have present in memory the circumstances of England in 1637. He must place himself as far as possible in the situation of a contemporary. The study of Milton's poetry compels the study of his time.'

The denunciatory passage has been called an excrescence, an incongruity, and it undoubtedly interrupts the quiet progress of the pastoral elegy. It is, however, immediately followed by an invocation to the river-god, Alpheus, and the Sicilian Muse, and this introduces some exquisite lines, calling on the valleys to cast their flowers on the tomb of Lycidas. The critics have differed about this passage, and some have dwelt particularly on the incongruity of including in the list of flowers such as bloom at different seasons. Professor Masson is not troubled by this thought. He says these lines form 'the most exquisite flower-and-colour passage in all Milton's poetry. His manuscript shows that he brought it to perfection by additions and afterthoughts;' and again, 'For musical sweetness and dainty richness of floral colour, it beats perhaps anything else in all Milton. It is the call upon all the valleys of the landscape, and the banks of all the secret streamlets, to yield up their choicest flowers, and those dearest to shepherds, that they may be strewn over the dead body of Lycidas.' Mr. R. C. Browne, the Clarendon Press editor, speaks of this passage as giving 'echoes of Perdita's catalogue of flowers,' and tells us it is imitated from Spenser's *Shepherd's Calendar*, April. But Mr. Ruskin, using it to illustrate the distinction between Fancy and Imagination, the former dealing with the outward appearances of things, the latter penetrating to the very heart and revealing their essential characters, deals fully with the lines in a beautiful passage which the reader may be glad to have quoted from his *Modern Painters*.

'Compare Milton's flowers in *Lycidas* with Perdita's. In Milton it happens, I think, generally, and in the case before us most certainly, that the imagination is mixed and broken with fancy, and so the strength of the imagery is part of iron and part of clay:—

"Bring the rathe primrose that forsaken dies (*Imagination*),
The tufted crow-toe, and pale jessamine (*Nugatory*),
The white pink, and the pansy freak'd with jet (*Fancy*),
The glowing violet (*Imagination*),
The musk-rose, and the well-attired wood-bine (*Fancy, vulgar*),
And every flower that sad embroidery wears." (*Mixed.*)

'Then hear Perdita:—

"O Proserpina,
For the flowers now, that, frighted, thou let'st fall
From Dis's waggon! daffodils,
That come before the swallows dare, and take
The winds of March with beauty; violets dim,
But sweeter than the lids of Juno's eyes
Or Cytherea's breath; pale primroses
That die unmarried ere they can behold
Bright Phœbus in his strength—a malady
Most incident to maids."

'Observe how the imagination in these last lines goes into the very inmost soul of every flower, after having touched them all at first with heavenly timidness, the shadow of Proserpina's, and gilded them with celestial gathering, and never stops on their spots, or their bodily shape, while Milton sticks in the stains upon them, and puts us off with that unhappy freak of jet in the very flower, that without this bit of paper-staining would have been the most precious to us all. "There's pansies, that's for thoughts."'

Returning to the text of *Lycidas* we must notice a few other allusions: *Amaranthus*, from Greek *a* not, and *maraino*, I wither, *amarantos*, unfading. 'A genus of flowers with richly coloured leaves, which retain their freshness long after they are gathered, *e.g.*, *love-lies-bleeding*.' *Bellerus*, the name of a Cornish giant, coined by Milton from *Bellerium*, the Latin name of a part of Cornwall. 'The guarded mount' is St. Michael's Mount, off Cornwall, and the 'great vision' is the Archangel Michael. *Namancos* near to Cape Finisterre, and *Bayonas hold* or castle in the same neighbourhood, according to a map of Milton's time.

The student's attention should also he directed to the scriptural references, some of which have already been mentioned in passing, while three are found near the close of the poem, namely:—

'The dear might of Him that walked the waves.'
'Unexpressive nuptial song,'—see Rev. xix., 9.
'And wipe the tears for ever from their eyes.'

Compare Rev. vii., 7. 'God shall wipe all tears from their eyes.'

The mixture of classical and scriptural allusions has been criticised as a blot on the poem; but the explanation is probably that Milton's familiarity with classical mythology was so complete that allusions to myths and legends were to him a natural and almost an essential part of poetical expression; and a further excuse for it is to be found in the perfect art and poetical fervour with which the ill-fitting materials have been fused together.

Dr. Johnson said of *Lycidas*, 'the diction is harsh, the rhymes uncertain, and the numbers unpleasing.' And again, 'In this poem there is no nature, for there is no truth; there is no art, for there is nothing new. Its form is that of a pastoral; easy, vulgar, and therefore disgusting; whatever images it can supply are long ago exhausted; and its inherent improbability always forces dissatisfaction on the mind.' Our readers will be prepared, we trust, to set aside this 'clumsy criticism' as it has been called, and agree rather with the opinions we venture to quote from more recent critics who have displayed more sympathising appreciation of the poet's work.

Mr. Stopford Brooke says, '*Lycidas* appeals not only to the imagination, but to the educated imagination. It is an advance on all his previous work, and fitly closes the poetic labour of his youth. It is needless to analyse it, and all criticism is weaker than

the poem itself. Yet we may say that one of its strange charms is its solemn undertone rising like a religious chaunt through the elegiac music; the sense of a stern national crisis in the midst of its pastoral mourning; the sense of Milton's grave force of character among the flowers and fancies of the poem; the sense of the Christian religion pervading the classical imagery.'

Mr. Mark Pattison says, 'In *Lycidas* we have reached the high-water mark of English poetry and of Milton's own production. A period of a century and a half was to elapse before poetry in England seemed in Wordsworth's *Ode on Immortality* (1807) to be rising towards the level of inspiration which it had once attained in *Lycidas*. And in the development of the Miltonic genius this wonderful dirge marks the culminating point.' Comparing it with *L'Allegro* and *Il Penseroso*, he goes on to remark that it 'opens up a deeper vein of feeling, a patriot passion so vehement and dangerous, that, like that which stirred the Hebrew prophet, it is compelled to veil itself from power, or from sympathy, in utterance made purposely enigmatical. . . . In *Lycidas* Milton's original picturesque vein is for the first time crossed with one of quite another sort, stern, determined, obscurely indicative of suppressed passion, and the resolution to do or die. The fanaticism of the Covenanter and the sad grace of Petrarch seem to meet in Milton's monody. Yet these opposites, instead of neutralising each other, are blended into one harmonious whole by the presiding, but invisible, genius of the poet. . . . The conflict which was commencing in the social life of England is also begun in Milton's own breast, and is reflected in *Lycidas*.' In his denunciation of the corrupt clergy 'we have the preluding mutterings of the storm, which was to sweep away mask and revel and song, to inhibit the drama, and suppress poetry. In *Lycidas*, for a moment, the tones of both ages—the past and the coming—are combined, and then Milton leaves behind him for ever the golden age, and one half of his poetic genius.'

Mr. Browne observes similar historical and biographical indications in this poem. 'In it,' he says, 'we hear the first note of the trumpet, which was to be to the English throne and Church as were those blown before the walls of Jericho. We see the first indications of the vigour and the coarseness that strengthen and disfigure the prose works. We have the intimation of two facts regarding Milton. He considered the day of his youth to be closed by the death of the friend of his youth—that on the morrow he was to seek "fresh woods and pastures new." But his choice has been made. His mantle is already of the Presbyterian colour. Henceforth there will be no more quiet communing with English oaks and rills. A brief holiday interposes between him and a "time of chiding," which with small respite will vex his spirit till, weary and worn, he rests at last;

> "Though fall'n on evil days,
> On evil days though fall'n, and evil tongues."'

As a further help to the student of *Lycidas* we would recommend him if he can spare the time to read the most famous poems of similar character by English writers. There are three other great monodies in which poets of a high order lament the death of friends. The first is *Adonais*, written by Shelley in memory of the poet Keats, who died in 1821. The second is *In Memoriam*, written by Tennyson to commemorate the death of Arthur Henry Hallam; and the third is *Thyrsis*, written by Matthew Arnold in memory of his friend Arthur Hugh Clough. These three poems are characteristic of the writers. *Adonais* is in the Spenserian stanza, is rapid, fiery, continuous, daring, luxuriant, magnificent. *In Memoriam*, in the form of quatrain which it has made famous, consists of a large number of separate poems full of the deepest reflection, but all having a thread of connection in the poet's loss of his friend. *Thyrsis* is a pastoral poem resembling Milton's in some of its imagery, but marked by the calm sadness and clear expression of its author. To enter into any detailed comparison of these poems with *Lycidas* would take us too far afield. But since comparative studies of this sort are most helpful in forming sound and broad opinions on literary subjects, we have ventured to make the suggestion in the hope that some may be induced to act upon it.

(To be continued.)

—o—

Certificate Examination, 1889.

Male Candidates.

FIRST YEAR.

Mental Arithmetic.

(TWENTY *minutes allowed for this Paper.*)

You are to enter the answer in the space (——) left for it after each question. Nothing is to be written on this paper except the particulars required and the answers (which must be written in ink only) to the questions. *No erasures or alterations are permitted.* They will be marked as errors.

1. $\cdot 7\dot{2} \times \cdot 7\dot{2}$ **as a vulgar fraction in lowest terms = (——).**

$$= \tfrac{72}{99} \times \tfrac{72}{99} = \tfrac{13}{\cancel{18}_{9}} \times \tfrac{\overset{4}{\cancel{8}}}{11} = \underline{\tfrac{52}{121}}. \text{ Ans.}$$

2. The square root of $(32\frac{1}{9} \div \cdot 09)$ **= the mixed number (——).**

$$\sqrt{\tfrac{289}{9} \times \tfrac{100}{9}} = \frac{17 \times 10}{9} = \underline{18\tfrac{8}{9}}. \text{ Ans.}$$

3. True discount on £472 4s. 11d. due 4 years hence at $4\frac{1}{2}$ **per cent. per annum simple interest = (——).**

$$\text{Discount} = \frac{4\frac{1}{2} \times 4}{100 + (4\frac{1}{2} \times 4)} \text{ or } \tfrac{18}{118} \text{ or } \tfrac{9}{59} \text{ of £472 4s. 11d.}$$
$$= £8\ 0s.\ 1d. \times 9$$
$$= \underline{£72\ 0s.\ 9d.}\ \text{Ans.}$$

4. When income-tax is 6d. in the pound, a man's net income was £312 3s. 3d.; when 9d. in the pound his income-tax = (——).

$$\text{Tax} = \frac{£312\ 3s.\ 3d.}{39} \times \tfrac{9}{6}.$$
$$= £8\ 0s.\ 1d. \times 1\tfrac{1}{2}d.$$
$$= \underline{£12\ 0s.\ 1\tfrac{1}{2}d.}\ \text{Ans.}$$

5. 25 miles 25 yards, reduced to yards = (——).

$$= (1{,}760 \times 25) + 25$$
$$= \underline{44{,}025.}\ \text{Ans.}$$

6. Simple interest on £129 12s. for 3 years at $3\frac{1}{8}$ **per cent. per annum = (——).**

$$\text{Interest} = 3\tfrac{1}{8}\ \% \text{ or } \tfrac{25}{800} \text{ or } \tfrac{1}{32} \text{ of £129 12s.} \times 3$$
$$= £4\ 1s. \times 3$$
$$= \underline{£12\ 3s.}\ \text{Ans.}$$

7. 432 things at 4s. 7½d. = (——).
= (4s. × 432) + (7½d. × 432)
= £$\frac{432}{5}$ + $\left(\frac{54}{432} \times \frac{5}{8}\right)$s.
= £86 8s. + £13 10s.
= £99 18s. Ans.

8. The mean proportional between 315 and 560 = (——).
= $\sqrt{9 \times 35 \times 16 \times 35}$
= 3 × 4 × 35
= 420. Ans.

9. A man's income is £566 13s. 4d. ; he spends in a year 85 per cent. of it ; his savings = (——).
Savings = 15 % of £566 13s. 4d.
= £28 6s. 8d. × 3
= £85. Ans.
or = 5 % of £566 13s. 4d. × 3
= $\frac{1}{20}$ of £1,700
= £85. Ans.

10. A, B, and C invest £530, £980, £1,140 in a business ; a year's profits are £279 5s. 5d. A's share = (——).
A's share = $\frac{530}{530 + 980 + 1,140}$ or $\frac{53}{260}$
or ⅕ of £279 5s. 5d.
= £55 17s. 1d. Ans.

11. $25^3 - 24^3$ = (——).
Difference = $(25 - 24)(25^2 + 25 \cdot 24 + 24^2)$
= 625 + 600 + 576
= 1,801. Ans.

12. Income from an investment at 4¾ per cent. is £180 10s. ; investment = (——).
= £180 10s. × $\frac{100}{4\frac{3}{4}}$
= £180 10s. × $\frac{400}{19}$
= £9 10s. × 400
= £3,800. Ans.

13. 3 cwts. 2 qrs. 8 lbs. at 11s. 8d. per cwt. = (——).
= 3 cwt. 2¾ qrs. at £$\frac{7}{12}$ per cwt.
= 3¼ cwt. at £$\frac{7}{12}$ per cwt.
= ($\frac{39}{4} \times \frac{7}{12}$)£
= £2 1s. 8d. Ans.
Or = (11s. 8d. × 3) + (½ of 11s. 8d.) + (¼ of ½ of 11s. 8d.)
= 35s. + 5s. 10d. + 10d.
= £2 1s. 8d. Ans.

14. 17s. 6d. expressed as the decimal of 3s. 0¾d. = (——).
= 210 ÷ $36\frac{3}{4}$
= $\frac{210}{1} \times \frac{4}{147}$
= $\frac{40}{7}$
= 5·714285. Ans.

ALTERNATIVE PAPER.

1. 25 cwt. 25 lbs. reduced to lbs. = (——).
= (112 × 25) + 25
= 2,825. Ans.

2. The mean proportional between 336 and 525 = (——).
= $\sqrt{336 \times 525}$
= $\sqrt{16 \times 21 \times 25 \times 21}$
= 4 × 5 × 21
= 420. Ans.

3. $26^3 - 25^3$ = (——).
Difference = $(26 - 25)(26^2 + 26 \cdot 25 + 25^2)$
= 676 + 650 + 625
= 1,951. Ans.

4. 2s. 7½d. expressed as the decimal of 9s. 2¼d. = (——).
= $\frac{31}{110} = \frac{31}{55}$
= ·285714. Ans.

5. The square root of $(22\frac{5}{16} \div 0{\cdot}4)$ = the mixed number (——).
= $\sqrt{\frac{361}{16} \times \frac{100}{4}} = \frac{19 \times 5}{4} = 23\frac{3}{4}$. Ans.

6. 3 cwt. 1 qr. 8 lbs. at 16s. 4d. per cwt.
= (16s. 4d. × 3) + (¼ of 16s. 4d.) + (¼ of 16s. 4d.)
= £2 9s. + 4s. 1d. + 1s. 2d.
= £2 14s. 3d. Ans.

7. Income from investment at 4¼ per cent. is £212 10s. ; investment = (——).
= £212 10s. × $\frac{100}{4\frac{1}{4}}$
= £212 10s. × $\frac{400}{17}$
= £12 10s. × 400
= £5,000. Ans.

8. A man's income is £466 13s. 4d., he spends in a year 87½ per cent. of it ; his savings = (——).
Savings = 12½ % or ⅛ of £466 13s. 4d.
= £58 6s. 8d. Ans.

9. A, B, and C invested £620, £760, and £1,100 in business a year's profits are £266 18s. 6d., A's share = (——).
A's share = $\frac{620}{620 + 760 + 1,100}$ or $\frac{62}{178}$ or ¼ of £266 18s. 6d.
= £66 14s. 7½d. Ans.

10. ·69 × ·69 as a vulgar fraction in lowest terms = (——).
= ·7 × $\frac{69}{99}$ = $\frac{7}{10} \times \frac{23}{33}$ = $\frac{161}{330}$. Ans.

11. 384 things at 4s. 9½d. each = (——).
= 384 at (5s. − 2½d.)
= 384 at (5s. − $\frac{1}{24}$ of 5s.)
= £96 − $\frac{1}{24}$ of £96
= £92. Ans.

12. Simple interest on £145 1s. 6d. for 3 years at 4½ per cent. per annum = (——).
Interest = 12½ % or ⅛ of £145 1s. 6d.
= £18 2s. 8¼d. Ans.

13. When income-tax is 9d. in the pound, a man's net income is £462 19s. 3d., when 6d. in the pound his income tax = (——).
Tax = £462 19s. 3d. × $\frac{9}{231} \times \frac{2}{9}$
77
= £6 0s. 3d. × 2
= £12 0s. 6d. Ans.

14. True discount on £171 4s. 9d. due 3½ years hence at 4 per cent. per annum simple interest = (——).
Discount = $\frac{3\frac{1}{2} \times 4}{100 + (3\frac{1}{2} \times 4)}$ or $\frac{14}{114}$ or $\frac{7}{57}$ of £171 4s. 9d.
= £3 0s. 1d. × 7
= £21 0s. 7d. Ans.

Male Candidates.

FIRST YEAR.

Arithmetic.

(TWO *hours and a* HALF *allowed for this Paper.*)

Candidates are not permitted to answer more than TEN questions, and are advised to answer the first.

The *solution* must be given at such length as to be intelligible to the examiner, otherwise the answer will be considered of no value.

1. (*a*) Explain clearly, as to beginners in fractions, why the addition of fractions with different denominators is effected by reducing each of the fractions to their least common denominator.

(*b*) How do you know, before proceeding to divide, whether a vulgar fraction can be expressed as a non-circulating decimal?

(*c*) What would be the advantages and what the disadvantages in adopting the decimal system in money, weights, and measures?

(*d*) Give rules for rapid mental solution in the following cases :—

(1) Cost for a year at so much per day ; (2) any number of things at £83 6s. 8d. each ; simple interest at 6¼ per cent.

(*a*) Suppose we have to add ⅓, ¼, and ⅕. L.C.M. of 3, 4, and 5 = 60.

$\frac{1}{3} = \frac{1 \times 20}{3 \times 20} = \frac{20}{60}$,

$\frac{1}{4} = \frac{1 \times 15}{4 \times 15} = \frac{15}{60}$,

$\frac{1}{5} = \frac{1 \times 12}{5 \times 12} = \frac{12}{60}$,

In each of the equivalent fractions we have unity divided into 60 equal parts, and those fractions represent respectively 20, 15, and 12 of such parts; therefore, the sum of the fractions must represent 20 + 15 + 12 or 47 such parts, that is, must be $\frac{47}{60}$.

(*b*) If the denominator of the fraction be composed solely of the factors 2 and 5 (factors of 10), or one of them, or of powers of 2 and 5, or one of them, then the vulgar fraction can be expressed as a non-circulating decimal.

(*c*) Advantages :—

(1) Reduction to higher or lower denominations could be seen at once.

(2) Addition, subtraction, multiplication, and division of money, weights, and measures would be reduced to the simple rules or the same operations in decimals.

(3) The processes of proportion, interest, &c., would be rendered much simpler.

Disadvantages :—

(1) The transition from the present to the proposed system would cause considerable inconvenience.

(2) No sum of money of the present coinage, except a multiple of 6d., could be paid exactly in a decimal coinage, if the system recommended were adopted, viz., taking the sovereign as the unit of money.

(3) Alterations would have to be made in our present coinage, weights, and measures.

(*d*) (1) For 365 days at 1d. per day = 365d.
$= (240 + 120 + 5)$d.
$= £1 + £\frac{1}{2} + 5$d.

Rule.—As many pounds as pence, half as many pounds, and 5 times cost for one day.

(2) At £83 6s. 8d. each.
£83 6s. 8d.
$= £83\frac{1}{3} = £\frac{250}{3} = £1000$.

Rule.—Add 000 to the number of the articles and divide by 12. Answer will be in pounds.

(3) At $6\frac{1}{4}$ per cent.

$6\frac{1}{4}$ per cent. $= \frac{6\frac{1}{4}}{100} = \frac{25}{400} = \frac{1}{16}$.

Rule.—Take $\frac{1}{16}$ of the sum.

2. If water expands when freezing so that a cubic foot of water becomes 1·089 feet of ice, find to two places of decimals how many cubic feet of water there are in a block of ice 9 feet long, $8\frac{1}{4}$ feet broad, and $8\frac{1}{2}$ feet high.

Quantity of water $= (9 \times 8\frac{1}{4} \times 8\frac{1}{2} \div 1{\cdot}089)$ cubic feet.

$$= \left(\frac{9}{1} \times \frac{33}{4} \times \frac{17}{2} \times \frac{1000}{1089}\right) \text{ cubic feet.}$$

$= \frac{2125}{11}$ cubic feet.
$= 572{\cdot}54$ cubic feet. Ans.

3. What is the smallest sum of money which will exactly contain each of the following sums: 4s. 2d., 6s. 4d., 11s. 11d., 17s. 5d.?

Sum = L.C.M. of 4s. 2d., 6s. 4d., 11s. 11d., 17s. 5d.
= L.C.M. of (50, 76, 143, 209)d.
= 11 | 50, 76, 143, 209
2 | 50, 76, 13, 19
25, 38, 13
$= (11 \times 2 \times 25 \times 38 \times 13)$d.
= 271,700d.
= 22,641s. 8d.
= £1,132 1s. 8d. Ans.

4. Reduce to their simplest forms:
$\frac{4807}{5681}$, and $\frac{11}{72}$ of $\frac{14}{99}$ of $\frac{9}{152} + \frac{133}{144}$ of $\frac{111}{266}$.

$\frac{4807}{5681} = \frac{4807 \div 437}{5681 \div 437} = \frac{11}{13}$. Ans.

$\frac{11}{72}$ of $\frac{77}{99}$ of $\frac{9}{152} + \frac{133}{144}$ of $\frac{111}{266}$

$= \frac{11}{864} + \frac{111}{288}$

$= \frac{11 + 666}{864}$

$= \frac{677}{864}$. Ans.

5. Find the value of $\frac{\cdot56}{\cdot56}$ of 4 tons 6 cwt. 58 lbs., and reduce the result to the decimal of a ton.

$$\text{Fraction} = \frac{\cdot56}{\cdot56} \text{ of } \frac{4 \text{ tons } 6 \text{ cwt. } 58 \text{ lbs.}}{1 \text{ ton}}$$

$$= \frac{\frac{56}{100}}{\frac{56}{100}} \text{ of } \frac{9690}{2240}$$

$$= \frac{56 \times 9 \times 969}{10 \times 56 \times 224}$$

$= \frac{1731}{400}$

$\therefore$ Decimal $= \underline{4{\cdot}275}$. Ans.

6. If it costs £34 1s. 3d. to decorate a wall-space, measuring 23 ft. 4 in. by 7 ft. 1 in., what will it cost for one measuring $5\frac{3}{4}$ yards by $2\frac{1}{2}$ yards; the style of decoration in the second being two-thirds as expensive as in the first case?

ft.	in.	yds.		£	s.	d.
23	4 :	$5\frac{3}{4}$	::	34	1	3 : cost.
ft.	in.	yds.				
7	1 :	$2\frac{1}{2}$				
3	:	2				

$$= \frac{17 \times 12 \times 7 \times 12 \times 2 \times 525}{280 \times 85 \times 3 \times 16} £$$

$= \frac{21}{4} £$

$= \underline{£15\ 15\text{s.}}$ Ans.

7. One clerk has 114 and a second clerk has 75 sheets to engross: they call in a third clerk, and agree to divide the work equally among the three, and to pay the third clerk a guinea. How much of this should the first clerk pay?

Quantity done by each clerk $= \frac{1}{3}(114 + 75)$ sheets
$= 63$ sheets,

$\therefore$ Payment by first clerk $= 21\text{s.} \times \frac{114 - 63}{63}$
$= \frac{51}{3}$s.
$= \underline{17\text{s.}}$ Ans.

8. A banker offered to take French bronze pennies from the public at the rate of 13 for a shilling. If he exchanged them again at the rate of 252 for a sovereign, what would he gain or lose on every thousand bronze pennies so received?

Number of bronze pennies gained on every thousand

$$= \frac{\{(13 \times 20) - 252\} \times 1000}{13 \times 20}$$

$$= \frac{8 \times 50}{13};$$

$$\therefore \text{Gain} = \frac{8 \times 50 \times 240}{13 \times 252}\text{d.}$$

$= \frac{8000}{273}$d.
$= \underline{2\text{s. } 5\frac{35}{273}\text{d.}}$ Ans.

9. Calculate $\frac{1}{\sqrt{\cdot5}}$ correctly to four places of decimals.

$$\frac{1}{\sqrt{\cdot5}} = \frac{1 \times \sqrt{\cdot5}}{\sqrt{\cdot5} \times \sqrt{\cdot5}} = \frac{\sqrt{\cdot5}}{\cdot5}$$
$$= \tfrac{1}{2} \text{ of } \sqrt{\cdot5}$$
$$= \tfrac{1}{2} \text{ of } \cdot7071\ldots$$
$$= \underline{\cdot3535\ldots} \text{ Ans.}$$

10. Find the length of the edge of a cube of metal which cost £2,703 14s. $5\frac{3}{4}$d. ; the value of a cubic inch being 4s. 2d.

Cubic content = (£2,703 14s. $5\frac{3}{4}$d. ÷ 4s. 2d.) cub. in.

$$= \frac{2595575}{4 \times 50} \text{ cub. in.}$$
$$= \frac{103823}{8} \text{ cub. in. ;}$$
$$= \sqrt[3]{\tfrac{103823}{8}} \text{ cub. in.}$$
$$= 103823(47$$

		64
$4^2 \times 300 = 4800$		39823
$4 \times 7 \times 30 = 840$		
$7^2 = 49$		
5689		39823

$$= \tfrac{47}{8} \text{ in.}$$
$$= \underline{1 \text{ ft. } 11\tfrac{1}{2} \text{ in.}} \text{ Ans.}$$

11. Find the true discount on £309 19s. $11\frac{1}{2}$d. due 6 months hence at 3 per cent. per annum.

Interest on £100 = £3 × ½ = £1½;

£	£	s.	d.	£
$101\frac{1}{2}$	309	19	$11\frac{1}{2}$	$1\frac{1}{2}$
2			3	3
203	929	19	$10\frac{1}{2}$	

∴ $101\frac{1}{2}$: 309 19 $11\frac{1}{2}$ :: $1\frac{1}{2}$: True Discount.

£4 11 $7\frac{1}{2}$. Ans.

12. Find the exact difference between the simple and compound interest on £8,675 for 4 years at 6 per cent. per annum.

£
8,675
520·5
9,195·5
551·73
9,747·23
584·8338
10,332·0638
619·923828
10,951·987628
8,675
£2,276·987628
20
s. 19·752560
12
d. 9·03072

£
8,675
6
52,050
4
£2,082·00

∴ Difference = £2,276 19s. 9·03072d. − £2,082

= £194 19s. 9·03072d. Ans.

13. A man invests a certain sum in the ordinary stock of a railway at 80, which pays a dividend of $3\frac{1}{4}$ per cent. at the end of a year. He then sells out at 84, and invests the proceeds in a 5 per cent. Stock at 125, and thus in the second year improves his income by £6 12s. How much did he originally invest, assuming that the prices of the Stocks given above include brokerage, &c.?

Increase in income for an investment of £80

$$= £\frac{84 \times 5}{125} - £3\tfrac{1}{4}$$
$$= (\tfrac{84}{25} - \tfrac{13}{4})£$$
$$= \frac{336 - 325}{100}£$$
$$= £\tfrac{11}{100};$$

£	£	s.	£
11	6	12	80
100			

∴ $\frac{11}{100}$: 6 12 :: 80 : Amount originally invested.

$$= \frac{12 \times 4}{11 \times 11} \times 100£$$
$$= \underline{£4,800.} \text{ Ans.}$$

(To be continued.)

Query Column.

RULES.

1. **Each correspondent is restricted to *one question*.** We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—*'The Query Editor,' The Practical Teacher, Pilgrim Street, Ludgate Hill, London, E.C.*

General.

1. ANXIOUS.—'What' in the first sentence stands for that which: that would be in the objective case, and which in the nominative. 'Evil' is used as a noun, and is in the objective case. Sight is nominative case, so is the word books. Just is an adverb of time, two is an adjective, but here used as a noun and in the objective case. 'What' in the second case is used adjectively qualifying sums. 'Scarcely' adverb qualifying bad, only is also an adverb qualifying the phrase, in a stupor.

Peculiar is an adjective and qualifies 'nothing.' Mostly is an adverb qualifying the statement 'was nice.' 'What' in the third case is parsed exactly as in the second case; it is adjectival and qualifies the noun apples. The word 'quoth' is a defective verb, and has only one form.

2. DRAWING.—You can complete your 'D' by passing in (*a*) Model Drawing on the Blackboard, and (*b*) Drawing in Light and Shade.

3. IGNORAMUS.—(1) Write to the secretary of the college in which you will reside. He will send you a copy of the syllabus, and tell you, if you care to ask him, the books you had best study. The books, of course, will depend upon the subjects selected for examination. (2) Deschanel's 'Natural Philosophy' is a good book (Blackie) or you can use Wright's (Longmans) for the elementary. You don't ask advice on the matter, and perhaps think you do not need any; but you would do well to let science alone at present, and study penmanship and composition. Science won't be of much use to you for your present purpose unless you can write a few sentences neatly and grammatically.

Trigonometry.

1. A. POWEL.—Prove

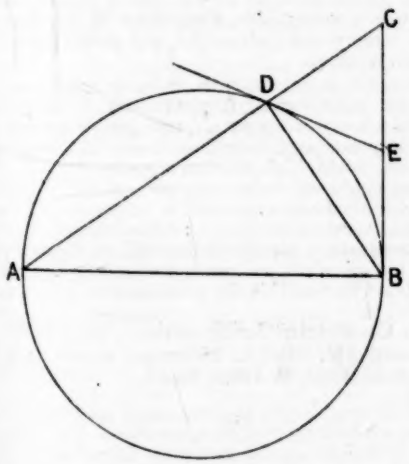
$$\tan 2A \tan 3A \tan 5A = \tan 5A - \tan 3A - \tan 2A. \qquad (Lock.)$$

$$\text{Tan } 5A - \tan 3A - \tan 2A$$
$$= \frac{\sin 5A}{\cos 5A} - \frac{\sin 3A}{\cos 3A} - \frac{\sin 2A}{\cos 2A}$$
$$= \frac{\sin 5A \cos 3A - \sin 3A \cos 5A}{\cos 3A \cos 5A} - \frac{\sin 2A}{\cos 2A}$$
$$= \frac{\sin (5A - 3A)}{\cos 3A \cos 5A} - \frac{\sin 2A}{\cos 2A}$$
$$= \frac{\sin 2A}{\cos 3A \cos 5A} - \frac{\sin 2A}{\cos 2A}$$
$$= \frac{\sin 2A (\cos 2A - \cos 3A \cos 5A)}{\cos 2A \cos 3A \cos 5A}$$
$$= \frac{\sin 2A \{\cos (5A - 3A) - \cos 3A \cos 5A\}}{\cos 2A \cos 3A \cos 5A}$$
$$= \frac{\sin 2A \{\cos 5A \cos 3A + \sin 5A \sin 3A - \cos 3A \cos 5A\}}{\cos 2A \cos 3A \cos 5A}$$
$$= \frac{\sin 2A \sin 3A \sin 5A}{\cos 2A \cos 3A \cos 5A}$$
$$= \tan 2A \tan 3A \tan 5A.$$

Geometry.

1. ST. SWITHIN.—If BC be a tangent at one extremity of a diameter AB of a circle, and from the other extremity any chord AD be drawn and produced to meet BC in C, prove that the tangent at D will bisect BC.

(Pupil Teachers' Exam. Papers, Fourth Year, Jan. 1890.)



Let the tangent at D cut BC in E. Join BD.

Proof.—$\angle$ EDB = $\angle$ DAB; (III. 32.)

Now $\angle$ ADB is a right angle, (III. 31.)

$\therefore$ $\angle$s DAB, DBA are together equal to a right angle, (I. 32.)

And $\angle$s DBA, DBE are together equal to a right angle, (Hyp.)

$\therefore$ $\angle$ DBE = $\angle$ DAB;

Wherefore $\angle$ DBE = $\angle$ EDB, (Ax. 1.)

$\therefore$ EB = ED. (I. 6.)

Again $\angle$s BDE, EDC are together equal to a right angle, (I. 13.)

And $\angle$s BAC, ACB are together equal to a right angle, (I. 32.)

And $\angle$ BDE = $\angle$ BAC,

Wherefore $\angle$ ECD = $\angle$ EDC,

$\therefore$ EC = ED. (I. 6.)

Wherefore EB = EC. (Ax. 1.)

Algebra.

1. HERBERTUS.—Simplify—

$$\frac{\left(1 + \frac{a}{x+y} + \frac{a^2}{(x+y)^2}\right)\left(1 - \frac{a^2}{(x+y)^2}\right)}{\left(1 - \frac{a^3}{(x+y)^3}\right)\left(1 + \frac{a}{x+y}\right)} \cdot$$
$$\frac{\left\{1 + \frac{a}{x+y} + \frac{a^2}{(x+y)^2}\right\}\left\{1 - \frac{a^2}{(x+y)^2}\right\}}{\left\{1 - \frac{a^3}{(x+y)^3}\right\}\left\{1 + \frac{a}{x+y}\right\}}$$
$$= \frac{\frac{\{(x+y)^2 + a(x+y) + a^2\}\{(x+y)^2 - a^2\}}{(x+y)^2 \times (x+y)^2}}{\frac{\{(x+y)^3 - a^3\}\{x+y+a\}}{(x+y)^3 \times (x+y)}}$$
$$= \frac{\{(x+y)^2 + a(x+y) + a^2\}(x+y+a)(x+y-a)}{(x+y-a)\{(x+y)^2 + a(x+y) + a^2\}(x+y+a)}$$
$$= 1. \text{ Ans.}$$

2. DENSE.—If $a + b + c + d = 0$, show that

$$a^3 + b^3 + c^3 + d^3 = 3(a+d)(b+d)(c+d).$$

If $a + b + c + d = 0$,

$$[(a+b) + (c+d)]^3 = 0,$$
$$(a+b)^3 + 3(a+b)^2(c+d) + 3(a+b)(c+d)^2 + (c+d)^3 = 0,$$
$$a^3 + 3a^2b + 3ab^2 + b^3 + 3a^2c + 6abc + 3b^2c + 3a^2d + 6abd + 3b^2d + 3ac^2 + 6acd + 3ad^2 + 3bc^2 + 6bcd + 3bd^2 + c^3 + 3c^2d + 3cd^2 + d^3 = 0,$$
$$a^3 + b^3 + c^3 + d^3 + 3ab(a+b+c+d) + 3ac(a+b+c+d) + 3ad(a+b+c+d) + 3bc(a+b+c+d) + 3bd(a+b+c+d) + 3cd(a+b+c+d) - 3abc - 3abd - 3acd - 3bcd = 0,$$
$$\therefore a^3 + b^3 + c^3 + d^3 = 3(abc + abd + acd + bcd).$$

$$3(a+d)(b+d)(c+d)$$
$$= 3(ab + ad + bd + d^2)(c+d)$$
$$= 3(abc + acd + bcd + cd^2 + abd + ad^2 + bd^2 + d^3)$$
$$= 3d^2(a+b+c+d) + 3(abc + abd + acd + bcd)$$
$$= 3(abc + abd + acd + bcd).$$
$$\therefore a^3 + b^3 + c^3 + d^3 = 3(a+d)(b+d)(c+d).$$

3. F. S.—Any prime divisor except 2, 3, and 5 is exactly contained in a number which consists of as many successive digits of any kind as the units less one in the prime divisor. Prove this. *(King's College Exam. Papers.)*

First proof.

Let p be any prime number greater than 5.

It will reduce to a recurring decimal whose period contains either $(p-1)$ figures or a measure of $(p-1)$ figures.

$\therefore$ Prime number greater than 5 can be reduced to a recurring decimal whose period contains one less figures than the number itself.

$$\therefore \frac{1}{p} = \frac{\text{period of } (p-1) \text{ figures}}{10^{p-1} - 1}$$

$p \times$ period of $(p-1)$ figures $= 10^{p-1} - 1$,

$\therefore p$ is a factor of $10^{p-1} - 1$,

$\therefore$ „ „ 999...$(p-1)$ figures

„ „ 9[111...$(p-1)$ figures]

„ „ 111...$(p-1)$ figures

$\therefore$ „ „ [111...$(p-1)$ figures] multiplied by any digit,

which proves proposition.

Example:—

$$\frac{1}{13} = .076923$$
$$= .076923076923$$
$$= \frac{076923076923}{999999999999},$$

$\therefore$ 13 is a factor of 999,999,999,999

„ „ „ 111,111,111,111

„ „ „ any 12 similar figures.

Second proof.
By Fermat's Theorem.

$$N^{n-1} - 1 = An,$$

n being a prime number, and N prime to n.
Let $N = 10$, and n a prime number, not 2 or 5,
$\therefore$ N and n are prime to one another,
$\therefore$ n is a factor of $10^{n-1} - 1$,
" " " 999...$(n-1)$ figures,
" " " 111...$(n-1)$ figures,
" " " $(n-1)$ similar figures,
which proves proposition.

NOTE.—The word *successive* in the question should have been *similar*.

4. HOPEFUL.—The hours are marked on the dial of a clock from 1 to 24. At what time between 19 and 20 o'clock will the hour and minutes hands be together? (Show how this can be solved both by equations involving one unknown quantity and two unknown quantities.)

(a) Let x = distance in min. gone by hour hand when they are together,
Then $24x$ = distance in min. gone by minute hand,
$\therefore 24x = x + (19 \times \frac{12}{12})$
$23x = 19 \times \frac{1}{2}$
$\therefore x = \frac{19}{46}$
$= 24\frac{3}{23}$.
$\therefore$ Time $= \{(19 \times \frac{5}{1}) + 24\frac{3}{23}\}$ min. past 19
$= (47\frac{1}{2} + 24\frac{3}{23})$ min. past 19
$= 49\frac{1}{46}$ min. past 19.
or $10\frac{22}{46}$ min. to 20.

(b) Let x = distance in min. gone by hour hand,
and let y = " " " minute hand;
Then (1) $y = x + (19 \times 2\frac{1}{2})$
(2) $y = 24x$
Subtracting] $23x - \frac{19}{2} = 0$
$\therefore x = \frac{19}{46}$
$= 24\frac{3}{23}$.
$\therefore$ Time $= (24\frac{3}{23} \times 24)$ min. past 19.
$= 49\frac{1}{46}$ min. past 19.

Arithmetic.

1. CATERHAM.—If 10 men or 15 boys can reap 20 acres of corn in 6 days, working 14 hours a day, how many boys must be employed to assist 3 men to reap 6 acres in $1\frac{3}{4}$ days of 8 hours a day? (*Barnard Smith.*)

ac.	:	ac.		
20	:	6		
days	:	days	:: 10 :	number of men required.
$1\frac{3}{4}$	:	6		
hrs.	:	hrs.		
8	:	14		

$$= \frac{6 \times \cancel{14} \times \cancel{7} \times 10}{\cancel{20} \times \cancel{7} \times \cancel{8}} \text{ men}$$
$= 18$ men.
$\therefore$ Number of boys required $= (18 - 3) \times \frac{11}{10}$
$= \frac{15 \times 3}{2}$
$= \frac{45}{2}$
$= 22\frac{1}{2}$
$= \underline{23}$. Ans.

2. HOPEFUL.—Three watches are set together.

The first gains 5 minutes a week, the second gains 8 minutes a week, and the third loses 4 minutes a week. When will they be together again? (*Matriculation.*)

Second gains 3 mins. weekly on first,
" " 1 hr. in $(60 \div 3)$ or 20 weeks,
" " 12 hrs. in (20×12) or 240 weeks;
$\therefore$ First and second are together in 240 weeks.
Second gains 12 min. weekly on third,
" " 1 hr. in $(60 \div 12)$ or 5 weeks,
" " 12 hrs. in (5×12) or 60 weeks;
$\therefore$ Second and third are together in 60 weeks.
Wherefore the three are together in 240 weeks. Ans.

—o—

Publications Reviewed.

Cicero de Finibus. Book I. Edited by S. Moses, M.A., and C. S. Fearenside, B.A. Univ. Corr. Coll. Series. London and Cambridge: W. B. Clive and Co.

The translation appended to this edition is decidedly above the average of the series in style. It is bright and lively, and is clearly the work of a scholar to whom the philosophical questions with which it is concerned are familiar, both in their modern and ancient treatment, so that there is an ease and lucidity in his rendering which should help to a satisfactory understanding of the book those of its readers who are less versed in the methods and terminology of philosophical discussion, whilst this freedom has not as a rule been gained at the expense of fidelity to the original. It is allowable, without lessening the emphasis of this praise, to point out some instances in which the translator has not perfectly reproduced the sense of his author. In section 8 Cicero speaks of the aversion felt by some of his contemporaries to reading Latin treatises of philosophy as due to their having been disgusted by bad Latin translations of poor Greek writers (*de malis Græcis Latine scripta deterius*). Quite a different idea is conveyed by the rendering of these words into 'translations from bad Greek into worse Latin.' So in section 21, *quæ etsi mihi nullo modo probantur* means 'Though *I* don't accept with these theories,' not 'though these theories are in nowise proved.' In section 25, *Optimi homines* is wrongly rendered 'The most estimable.' Cicero is explaining why the ethical doctrine of Epicurus was so popular with the crowd. These 'good people,' he says, with a strong spice of contempt in the expression, fail to comprehend their master, and make him contradict his own teaching.

The notes do not strike us as being equally successful with the translation. A good many of them have a certain scissors-and-paste air, and greater severity might have been exercised in their selection. It is hardly necessary, one would think, to warn a reader of the *de Finibus* against confusing *tribus*, the abl. of *tres*, with *tribus*, tribe; nor is there much profit to be got out of the remark on the word *Macedonum*: 'Macedones, inhabitants of Macedonia, a district in the N.E. of Greece.' There are a few misprints, as *lenitur* for *leniter*, in section 26; and 'saw' for 'said' in the translation of section 19.

The Complete Arithmetic. Standards III. and IV. By R. Lishman. London: Edward Arnold, 18, Warwick Square.

Mr. Lishman's idea is, that none of the books at present in use are built up on a correct method. He is of opinion that problems should naturally follow simple mental concrete and abstract examples. With this end in view, he has compiled this Arithmetic, two numbers being to hand. His plan is, the first four rules being known, to give a mental exercise on a specific operation and build upon it a series of ten or more problems, varying and increasing in difficulty, for written work. He succeeds very well, and if the mental exercise is largely increased by similar examples before the written exercise is commenced there is no doubt increased ability to work problems, as well as intellectual activity, will be the result. A series of examination tests, and, in Standard IV., long tots and mental exercises preparatory to Standard V. work, closes each number, which is sold at twopence.

Graphic School Atlas. London: George Philip & Son.

Contains 110 maps and diagrams, physical and political, printed in colours, and is suitable for use by all the standards in elementary schools. It is a very cheap shillingsworth.

Livy: Book I. Edited by A. H. Allcroft, M.A., and W. F. Masom, B.A. Univ. Corr. Coll. Series. London and Cambridge: W. B. Clive and Co.

We cannot altogether congratulate the University Correspondence College on this number of its series. The introductory remarks on Livy and the known facts of the Regal Period are well put together and commendably brief in proportion to the amount of matter they contain. Nor is it with the annotation especially that we find fault, notwithstanding a number of omissions, and some not too accurate renderings and elucidations. Amongst the former the absence of any notes on *Consualia* in ch. 9, on *oriundi* in ch. 17, *erogaretur* in ch. 20, is remarkable: on the name *Camenae* we are referred in the index of proper names to the note on the place in ch. 21, where the word occurs; but on turning up the reference, we find the expected note wanting. The name *Jupiter Elicius* ought to have obtained some notice in ch. 21. Under the head of inaccuracies, we might quote the translation of *animum virtutibus temperatum* by 'mind regulated by virtue.' The use of the plural, *virtutibus*, ought to have prevented this mistake: the sense of *temperatum* here is obviously 'compounded' not '*regulated*.' Livy's point is that the virtues which composed the character of Numa were native, not the result of the teaching or training of others. We do not accept the note in ch. 25, s. 3, on *fecissent* as correct. The subjunctive is rather to be put down as a case of virtual *oratio obliqua* than as consecutive after the relative *quam*. Again, in ch. 19, s. 1, it is a misleading remark to call the *eam* needless. True, it is not indispensable to the sense; at the same time its omission alters the emphasis; and the same redundancy is not unknown to the English language, where a similar emphasis is sought. We find the same kind of fault with the statement (ch. 8, s. 4), that *hominum* in the phrase *ad id, quod tum hominum erat* qualifies partitively *id*, not *quod*. The complete expression, to which parallels may not infrequently be found, especially in Cæsar, would be *ad id hominum, quod tum hominum erat*. As a rule, and naturally so, the word *hominum* would be omitted in the relative, not the antecedent clause; but this does not justify one in saying, in the rarer opposite case, that the genitive depends on the *id* and not on the *quod*. But we have far stronger objections to the annexed translation. It is, in our opinion, unsatisfactory in every respect. Its adherence at all costs to the structure of the Latin period destroys any pretensions it might make to represent, however inadequately, Livy's narrative in English prose. But here a plausible defence may be made on the ground that the aim in view was to guide the pupil to the right construction of Livy's sentences and the right sense of his expressions. Putting aside the question whether or no this defence is good—we think it holds good only in part—we must still urge that, judged in this aspect, the translation is often a misleading guide. Let us bring some instances in point. In ch. 9 *factum purgantium* is translated 'atoning for their deed' instead of 'excusing their deed.' In ch. 11 'they did nothing in rage or passion' seems tautological, till we find the Latin to be *per iram aut cupiditatem*. A little lower down *ne quid usquam fidum proditori esset* is rendered 'that a traitor might never anywhere have any credit.' It should rather be 'that there might nowhere be any security for a traitor.' In ch. 13 *sine alteris vestrum* means 'without *one* of the two of you,' not 'without *either* of the two of you.' *Tumultus*, in ch. 14, refers rather to the disorderly rush of scared country-folk into the city than to a panic conveyed from the country into the city. In ch. 17 *singulos* is translated 'each,' which destroys the sense: it should be rendered by 'individuals.' In ch. 27 *erigit aciem* is wrongly made to mean 'he drew out his line.' It is a common military term in Livy in the sense of marching troops up a hill. As to the bad style of the translation two examples may suffice, though there is not a page which would not supply others abundantly. In describing the fight of the Horatii and Curiatii (ch. 24) Livy says, *Cum trigeminis agunt reges;* the translator, 'The kings entered into negotiations with *the triplets*.' Ch. 16 describes the disappearance of Romulus. In a story like this we see Livy at his best. Compare his ingenious arrangement and easy flow with the following travesty: 'The men of Rome, when their panic was at length allayed, as soon as calm and still daylight had returned after such stormy weather, seeing the King's seat vacant, though they quite believed the Fathers, who had stood nearest, that he had been carried aloft by a whirlwind, yet for a long space preserved a gloomy silence, as if stricken with the fear of orphanhood.'

Elementary Mechanics. Part III. London: Blackie & Son.

This covers the third stage of the Specific Subject *Mechanics* in the Code very fully and very clearly. It is well illustrated, its facts are clearly stated, and the exercises suitable and varied. An average sixth or seventh standard scholar would, with attention, be able to understand the book almost without the aid of a tutor. With a competent teacher, success would be certain.

The Round World. A Reading Book of Geography for Standard II. New Edition. London: George Bell & Sons.

The preface says 'that in this edition, the vocabulary has been greatly simplified. So much care has been taken in the choice of words, that the text now presents no difficulty which cannot readily be mastered by an ordinary reader of eight or nine years of age.' We can hardly endorse the latter statement, and we think there is still further room for simplification. Although the writer has had many years experience as an examiner, he has not had the difficulties to overcome which a practical teacher has, and he cannot yet write down to the capacities of those who make up the bulk of the children in our schools. The book is, however, well written, and marked by all the accuracy of detail which characterises the previous works of the author. The illustrations are numerous and suitable, the selection of poetical pieces, in most cases, judicious, while the printing and binding are all that could be desired.

Progressive Object Lessons for Infant Schools. By W. Taylor. London: National Society's Depository, Broad Sanctuary.

The aim of this book is two-fold. It is meant to supplement a former work by the same author by furnishing additional lessons and, as its name indicates, to give a series of object lessons suitable to the various classes in infant schools which shall be progressive in their scope, difficulty, quantity of matter, and treatment. 'A dozen pages of the introduction are devoted to the consideration of the important question of the illustration of object lessons. The remarks made and the advice tendered are exceedingly valuable and will well repay ardent study by all infant teachers. The book is embellished with several diagrams to show the method of illustrating the lessons by drawings on the blackboard, and the three plates showing how effective illustrations in coloured chalks may be made will prove very useful. There are four courses of object lessons in the book, and they fulfil in a marked degree the object contemplated. The lessons for the youngest children are on the class room and its contents, a few common objects in the house, and on familiar living things. The second course embraces common articles of food, clothing, and common things. The third course includes natural objects, animals, food, and country scenes. The fourth is very varied and contains lessons on the larger animals, vegetable products, birds, lowly creatures, minerals, and miscellaneous lessons. The book is a veritable storehouse of material and method for infant teachers.

Science applied to Work. By J. A. Bower. London: Cassell & Co.

This is a small book of 128 pages and 66 illustrations. It is intended for the artisan section of the Home Reading Union. It is hoped that it will afford an easy introduction to mechanics, free from mathematical formulæ. The author has aimed at simplicity and accuracy. He has tried to do away with the Rule of Thumb and supply more rational directions. It is a praiseworthy attempt to attract those who are not very anxious to learn and it is likely to be of service. We need hardly say that, in these days, when an excellent elementary education can be had for a trifle, and when boys and girls work sums at school which require much more attention and ability to understand than any statement in this book, that those who are really in earnest to learn something about mechanics, had better not take up a book which excludes mathematical formulæ on principle.

A Plea for Slöjd. By J. Franzen. London: George Philip & Son, 32, Fleet Street.

Miss Anna Strömsten of the Victoria College, Belfast, has translated from the Swedish, Herr Franzen's essay on Slöjd. It can be read in an hour, and by those who wish to be convinced of the necessity of introducing manual work into schools, it will be read with pleasure. The plea for Slöjd is based upon the following propositions. (1) Children's longing for activity must be satisfied, and a right direction given to their activities. Nothing but bodily work can satisfy this longing. (2) A sound education can only result from the harmonious development of every faculty and power, this including the training of the hand and eye. If bodily work be treated as a means of education, it will serve to develop the child's general capacities and talents. (3) From both the hygienic and moral points of view, bodily work is of great value. It serves better than anything else to counteract the evil effects of intellectual work and sitting still. (4) Children should be taught to respect all kinds of honest useful work. Bodily work alone can give children respect for bodily work, and it is of such extreme importance, that time must be found for it in our educational establishments. These propositions are fairly worked out, and a short description of wood Slöjd as practised at Naas is added. It is clearly insisted upon, that no intention of teaching a trade is held, and that the money result of the labour must be neglected, and the educational value of the system only considered.

The Teacher's Mental Arithmetic. Standards VI. and VII. By T. J. Macnamara. London: A. G. Dawson.

The earlier numbers of this Mental Arithmetic have been already noticed in the *Practical Teacher*. The part for Standards VI. and VII. consists almost entirely of examples, with a simple statement of the processes. The examples, which are practical and suitable, cover almost the whole ground of the seven standards, there being numerous exercises in the simple rules, money, weights and measures, fractions, and percentages of every kind. The part has stiff covers, fifty-six pages, and is sold for ninepence.

In our next issue another paper by Miss J. W. Warren (Inspectress to the Leicester School Board), on 'Practical Needlework in Elementary Schools will appear.'

The School Song, unavoidably crowded out this month, will also appear.

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